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INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quelque soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

"................ per litora spargite muscum,
Naiades, et circùm vitreos considite fontes :
Pollice virgineo teneros hìc carpite flores :
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas ;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 1. JANUARY 1858.

I.—*On the Propagation of the* Desmidieæ *and* Diatomeæ. By W. Hofmeister*.

NUMEROUS as the researches have been, published during the last ten years†, on the conjugation of the Desmidieæ and Diatomeæ; satisfactorily as these have in some cases made out the course of conjugation, the behaviour of the mother-cells, and the formation of the conjugation-cell,—yet little is certainly known respecting the subsequent fate of the spores produced by conjugation, especially in the Desmidieæ—a natural consequence of the difficulties of the observation, in which the inquirer is dependent almost more than anywhere else upon accident. The following pages will furnish information on this point, in reference to two, confessedly very nearly allied species of Desmidieæ.

Cosmarium tetraophthalmum, Kg., collected in May 1853, with many other Desmidieæ, in a little pool abounding in such or-

* Bericht. K. Sachs. Gesellsch. d. Wissensch. Feb. 21, 1857. Translated by Arthur Henfrey, F.R.S. &c.

† Thwaites, Ann. Nat. Hist. 1847–49. Ralfs, British Desmidieæ, London, 1848. Braun, Verjüngung an der Natur (1849) (Ray Translation, 1853, p. 281). Smith, British Diatomaceæ, ii. London, 1856.

ganisms, in a boggy locality near Leipsic, exhibited numerous conjugated specimens. The conjugated individuals displayed exactly the behaviour which Ralfs* has represented and Al. Braun† described of those of *Cosmarium margaritiferum*. The *Cosmaria* which had commenced the conjugation-process appeared cracked apart at the constricted place in the middle. Into each of the halves of the tuberculated cell-coat of the two mother-individuals, extended a continuation of the membrane of the conjugation-cell. This smooth membrane completely lined the interior of the tuberculated half-shells. The contents of the conjugation-cell revealed no definite arrangement; they were mostly accumulated in the middle into an irregularly-shaped ball; in other cases separated into several such balls, part of which extended even into the split half-shells of the mother-cell (Pl. I. fig. 2). With these conjugated individuals, in the same fluid, occurred (very sparingly) particular specimens which bore, in the middle space between the two separated half-shells, a broad, delicate-walled utricle, the circumference of which about equalled that of the two half-cells taken together. The arrangement of the cell-contents in the primary portions of the cell did not appear essentially altered; the contents of the intermediate expansion consisted of a thick coat, upon the wall of granular protoplasm with sparingly scattered chlorophyll (fig. 1). This condition is probably that which immediately precedes conjugation‡, originating by excretion of new cellulose at the deepest part of the constriction, after the cracking of the membrane and separation of the primary halves of the cell, exactly as in normal cell-division, from which this process can only be distinguished by the omission of the formation of a septum at the narrowest part of the isthmus. Similar phænomena have been observed by Nägeli in *Cosmarium crenulatum*§, and by Mrs. Herbert Thomas|| in *Cosmarium margaritiferum* (scarcely specifically distinct from *C. tetraophthalmum*), only that here the intermediate piece of the Alga did not conjugate with the similar piece of another individual, but, producing tubercles on its outer surface, continued the vegetative life.

In other conjugation-cells there lay in the middle part of the conjugation-cell, a globular cell enveloped in a rather thick membrane, of gelatinous aspect, and smooth on the outside (the

* *Loc. cit.* pl. 16. fig. 2 *d*.

† Verjüngung, p. 315 (Ray Translation, p. 295).

‡ *Vide* Nägeli, Gatt. einz. Algen. Zurich, 1849, p. 118, pl. 7. fig. 6 *g*, *Cosmarium rupestre*.

§ Gatt. einzell. Algen, p. 118, pl. 7. fig. 7 *b*.

|| Quarterly Journal of Microscop. Science, iii. p. 35. pl. 5. figs. 17, 18 (1855).

spore). No intermediate stages could be found between this and the previously-described condition. Experiments, in which an attempt was made to obtain a completion of the less-advanced conjugation under the microscope, all failed. Apparently the conjugation-cell is exceedingly sensitive to any external injury, especially to contact with foreign bodies. Very probably the contents, in the above-described cases, were already abnormally altered, and incapable of further development.

In other conjugation-cells the young spore displayed a still thicker membrane, covered on the outside with truncate-conical elevations, in which membrane could be detected a composition of two colourless layers. The outer of these layers remained clear and transparent even in the advance to maturity. Its elevations became developed into rather long spines, which forked at the apices into two or four branches*. The deeper-seated layer of the spore-membrane meanwhile assumed a dark-brown colour. By rolling under the covering-glass, the tough, colourless, outer layer may be readily stripped from the inner, more brittle, brown layer; then the latter appears covered on its outer surface with slight elevations, similar to those which first appeared upon the young spore (Pl. I. fig. 3). The brown layer of the spore-coat encloses a third, delicate, colourless layer (perhaps the primary membrane of the spore) which immediately envelopes the cell-contents.

At the beginning of July, the green contents of all the spores appeared conglobated into a spherical mass with sharp outlines, which, lying free in the middle part of the cell, nowhere touched its internal wall. Three weeks later, in many of the spores these contents appeared separated into two flattened ellipsoidal masses (Pl. I. fig. 3); when I cracked the cell by careful pressure, I was sometimes successful in driving out one or both of the masses of contents in an uninjured condition. They could then be recognized, beyond all doubt, as primordial cells; bodies destitute of a solid cell-membrane, having a thin coat of protoplasm which 'bubbled' out in water, to which adhered a thick investment, coloured bright green by numerous imbedded chlorophyll-granules, surrounding a central cavity filled with transparent fluid. The fluid contained in the spore in which the two primordial cells were immersed, was not colourless, but rendered turbid by numerous immeasurably small granules exhibiting molecular motion. In August each of the ellipsoidal primordial cells had divided into two globular cells, of similar character to the mother-cell. Towards the end of September, some of the spores exhibited another such division, so that they then con-

* 'Spines finally branched.' Ralfs, *l. c.* p. 98. The figure represents a spore not quite ripe, with unbranched spines.

tained eight, not globular, but strongly flattened primordial cells. Most, however, passed through the winter-rest unchanged, during which the majority died. At the beginning of April of the next year, the spinous, transparent, outermost layer of the coat was more or less completely decayed on all the spores, even on those which were still to be recognized as living by the vivid green colour of the contents. All the spores still alive contained at least eight, many sixteen daughter-cells, all very strongly flattened, almost discoid. In several spores the outline of the daughter-cells was no longer circular, but displayed two shallow lateral notches. The still-existing, brownish, inner layer of the spore-coat was now seen to be softened; it no longer exhibited its former brittleness, and it was difficult to crack it by pressure. Daughter-cells whose lateral constrictions were most strongly marked, were about half as large again as the circular, whose diameter about equalled that of the isthmus of the former, and they almost entirely filled up the cavity of the spore. When these were pressed out from the crushed spore, their form and size agreed almost exactly with that of *Cosmarium Meneghinii**.

I saw similar phænomena in the spores of *Cosmarium undulatum*, Corda, in which the investigation is rendered very difficult by the minute size, and which, cultivated for some months in my room, entered abundantly into conjugation. In this, again, I observed the contraction of the green contents of the cell into a globule occupying the central part; the division of this ball into two, four, eight, and sixteen spherical masses; finally, the transition of these daughter-cells of the last generation from the form of circular lenticular bodies into two-lobed ones like the mother-plant. Here the young *Cosmaria*, whose diameter amounted to scarcely $\frac{1}{3}$th or $\frac{1}{4}$th of that of the mother-plant, were set free by the very gradual solution of the membrane of the spore. A similar process very probably occurred in *Cosmarium tetraophthalmum*, but could not be observed there, from the circumstance that all the materials had been used up in the investigation.

These facts place it beyond doubt that the contents of the spores produced by the conjugation of two individuals of *Cosmarium*, are transformed by repeated binary division into eight or sixteen daughter-cells, which assume the form of the mother-cell, and finally become free by the solution of the wall of the spore. Such behaviour of the spores had indeed been rendered probable before, by the discovery of the vesicular structure observed by Focke† and Ralfs‡, which enclosed a

* Ralfs, *l. c.* p. 96. pl. 15. fig. 6.
† Physiol. Studien, Heft 1.
‡ British Desmidieæ, p. 164. pl. 27. fig. 2.

number of small *Closteria*, for the most part beginning to divide*. But the certainty which can only be given by direct observation of the development was altogether wanting.

The development of four daughter-cells in the interior of spores produced by the conjugation of two individuals (with participation of the whole of the cell-membrane), has been demonstrated by Alex. Braun† for the Palmellacean *Palmoglœa macrococca*, Kütz. (?). Closer still than this species, to the difficult-to-be-defined limits between Palmellaceæ and Desmidieæ, stands another form of the same genus, agreeing almost in external form with the *Penium Jenneri*, Ralfs, but one-half smaller; in form and magnitude like *Mesotænium Endlicherianum*, Näg.‡ In particular individuals the chlorophyll of the contents exhibited the arrangement described by Nägeli as typical for his *Mesotænium*, forming a band-shaped body lying in the longitudinal axis of the cell, similar to what Alex. Braun has observed in *Palmoglœa macrococca*§. This form, perhaps *P. protuberans*, Kütz., occurred in many thousands of specimens on the surface of water, in a vessel in which other Algæ were cultivated. The closely-crowded individuals of *Palmoglœa* formed a connected green film with a dry upper surface, to which the air strongly adhered. Each cell contained a very distinct nucleus in the centre, the diameter of which amounted to a fourth or a third of that of the cell. In each half of the cell occurred, in elongated cells two, in shorter cells one, globular chlorophyll-mass, containing starch (fig. 11). The central nucleus vanished before the division of the cell (fig. 12), a new nucleus then making its appearance in each half (fig. 15). The origin of the lateral in the place occupied by the primary nucleus, and the subsequent removal of the halves resulting from division towards the ends of the cell, as occurs in *Spirogyra*‖, is altogether improbable in this *Palmoglœa*; for not only were cells (about to divide) temporarily devoid of a nucleus met with frequently, but the larger chlorophyll-mass lying in the path of the secondary nuclei would offer an obstacle to its progress scarcely to be overcome. Divi-

* See 'Verjüngung,' &c. p. 143 (Ray Translation, 1853, p. 134). I have also often seen such cysts, which probably belonged to *Closterium acerosum*: in the spring of 1855, also, some which, occurring in company with *Penium closterioides*, Ralfs, and containing totally uncurved individuals, must be referred to this plant. *Closterium acerosum* was not present in this water. I was not successful in discovering intermediate stages between them and the spores.

† Al. Braun, Verjüngung, &c. pp. 145, 351. pl. 1. fig. 42 (Ray Translation, 1853, pp. 136, 285. pl. 1 & 2).

‡ Nägeli, Einzell. Algen, p. 109.

§ Verjüngung, p. 350. pl. 1. fig. 11 (Ray Transl. p. 328. pl. 1. fig. 11).

‖ Al. Braun, Verjüngung, p. 258 (Ray Translation, p. 240); Pringsheim, Bau der Pflanzenzelle. Berlin, 1854, pl. 3. fig. 1 *a*.

sion of the cell by a septum passing across it, whose composition of two layers could not be directly detected, was always followed by a separation of the daughter-cells, proceeding from without inwards. The annular grooves formed in this way became deeper and deeper, until at length the two halves appeared completely detached (figs. 13, 14). The formation of a cross-septum and the mode of division of the daughter-cells occur therefore in the same way as appears general in the Desmidieæ*.

When the cells are about to conjugate, they protrude from one of the lateral surfaces, mostly not accurately in the middle, a process of not inconsiderable length, often far exceeding the transverse diameter of the cell (fig. 18), differing in some degree, by greater slenderness and sharper apiculation, from the short, blunt process of *P. macrococca*†. When two such processes meet, the firm cell-membrane disappears at the point of contact, and the pellicular coats of the contents of the two cells unite. The long canal connecting the two individuals (fig. 19) sometimes increases in thickness, at the same time becoming considerably shorter, and thus approximating the conjugated cells (fig. 20). The granular layers of the two cells only now make their way into the connecting canal, at first still evidently separate at their point of contact (fig. 19). This boundary disappears; the connecting piece of the cells continues to grow broader and simultaneously shorter; a continually greater portion of their adjacent side-walls enters into the composition of the canal, until at length the two individuals appear blended into a single body, at first of irregular quadrangular shape (fig. 21), just as in *P. macrococca*‡. Subsequently the spore thus formed acquires a regular quadrate form; its contents gradually lose their green colour, and turn to a red-brown. Of solution of the walls of the conjugated cells, or formation of new membrane around the conjugation-cell, nothing whatever can be seen here, as may be the case also in *P. macrococca*. The conjugation of the Palmoglœeæ, as I have already advanced elsewhere§, undoubtedly affords an example, in the course of development, of cellulose membranes, capable of very considerable contraction, diminishing their superficial dimensions. This diminution of the surface to ⅔rds of the original extent is accompanied by great increase of thickness of the membrane. This increase of thickness of the coat depends, if not exclusively, yet certainly in part, upon its contraction.

* Clearly recognized in *Euastrum, Cosmarium, Staurastrum, Docidium.*

† Al. Braun, *l. c.* (Translation, p. 328).

‡ Al. Braun, *l. c.* pl. 1. figs. 22–26 (Translation, pl. 1. fig. 22; pl. 2. figs. 1–4).

§ Flora, 1855, p. 534.

Conjugation is far more rarely met with in the Diatomaceæ than in the Desmidieæ. It appears that this process occurs here only at particular epochs, differing according to the seasons, happening simultaneously in all individuals, and quickly completed. Frequently as indications of conjugation having taken place have been met with (the occurrence of individuals of the same species, of remarkable diversity of size, side by side, in free Diatomeæ, ex. gr. *Pinnularia viridis, Surirella bifrons, Staurosigma lacustre,* all the year round; besides the occurrence of shorter or longer rows of cells of about double the diameter in the bands, of the forms remaining connected by the lateral surfaces, ex. gr. *Melosira, Codosira*),—yet it has seldom happened that they have been met with in the moment of conjugation. Since the classic researches of Thwaites* upon this subject, the knowledge of it has on the whole been but little advanced by the observations of Focke (conjugation of *Surirella*†), Griffith‡ (conjugation of *Navicula*), W. Smith § and Carter|| (conjugation of *Cocconeis, Cymbella, Amphora*). The following cases have been observed:

Formation of a single conjugation-cell, dividing very soon after its origin: in *Himantidium pectorale*¶, *Cymbella Kützingiana***, *Cocconeis Pediculus*††, *Cocconeis Placentula*‡‡, *Gomphonema lanceolatum*§§, *Schizonema Grevillii* ||||, *Orthosira orichalcea*¶¶, *O. Dickiei****, remarkable from the repeated throwing-off of the coats of the conjugation-cell, the cracked halves of which clothed the conical ends of the conjugation-cell in shape of funnels; *Orthosira varians*†††, *Surirella bifrons*‡‡‡, and a *Navicula*§§§, not specifically determined. Here belongs also the only conjugation of a Diatomacean that I have seen, that of

* Ann. Nat. Hist. xix. p. 200; ser. 2, i. p. 161. Summed up in Al. Braun's 'Verjüngung,' p. 305 (Translation, p. 285).

† Physiologisch. Studien, ii. p. 39. pl. 5. figs. 19–22 (1854).

‡ Ann. Nat. Hist. ser. 2. xvi. p. 90.

§ British Diatomaceæ, ii. p. 10. pl. A–E (1856).

|| Ann. Nat. Hist. ser. 2. xvii. pl. 1 (1856).

¶ Thwaites, Ann. Nat. Hist. xix.; Smith, *l. c.* pl. D. f. 280. i.–iii. (Smith's figures, agreeing exactly with Thwaites's, are evidently not mere copies of them, but new drawings from the same preparations.)

** Thwaites, Ann. Nat. Hist. ser. 2. i. pl. 2. figs. 1–5. Smith, pl. B. fig. 47. i. ii. iii.

†† Carter, *l. c.* pl. 1. fig. 2 J.

‡‡ Smith, pl. B. fig. 32.

§§ Smith, pl. D. fig. 214. i.

|||| Smith, pl. E. fig. 364.

¶¶ Thwaites, Ann. Nat. Hist. ser. 2. i. pl. 11. fig. *b.* (as *O. crenulata*); Smith, pl. E. fig. 337.

*** Thwaites, *l. c.* pl. 12. figs. 1–7.

††† Thwaites, *l. c.* pl. 11. fig. A.

‡‡‡ Focke, Physiol. Studien, ii. pl. 5. figs. 19–22; pl. 6. fig. 42. (Bremen, 1854.)

§§§ J. W. Griffith, Ann. Nat. Hist. ser. 2. xvi. p. 90.

Cyclotella operculata, conjugation-cells of which, with adherent empty coats of the mother-cells, I found abundantly in ditches of a marshy meadow not far from Leipsic, in October 1852. They were not distinguishable in any essential respects from the *Cyclotella Kützingiana* figured by Thwaites.

Next to these cases of the formation in the first place of only one conjugation-cell, come a series of observations in which two new cells were seen between the empty conjugated mother-cells, without any convincing evidence being offered of a division of the mother-cells having occurred just before conjugation, as in the cases hereafter to be mentioned;—where rather the position of the empty cells in relation to the conjugation-cells, and the affinity of the forms in question to some in which the entire development has been observed, render it probable that the unicellular condition of the conjugation-cell has hitherto escaped observation. In this group are to be counted *Cocconema lanceolatum**, *Cocconema Cistula*, *Gomphonema dichotomum*, *lanceolatum*†, *marinum*‡, *Achnanthes longipes*§, *Rhabdonema arcuatum*||, *Colletonema subcohærens*.

In a smaller number of Diatomeæ, species of the genera, so nearly allied together, *Epithemia*, *Cymbella*, and *Amphora*¶, the conjugation is immediately preceded by a division of the mother-cells into two, analogous to the division of the cells of *Closterium rostratum* when about to conjugate. This division is longitudinal, taking place exactly as in the vegetative division in *Cymbella Pediculus* **, *Amphora ovalis*††, and *Epithemia Sorex*‡‡, but transverse and in a direction crossing that of the vegetative division in *Epithemia turgida*, *gibba*, and *verrucosa*§§.

Recent observations show distinctly that the conjugation of the Diatomeæ agrees in all essential points with that of the Desmidieæ. When a cell is about to conjugate, there is produced in it a coat round the entire contents, accurately lining the old membrane, but not adhering to it. The growth of this coat cracks the old cell-membrane exactly in the same way as occurs in vegetative division. From the fissure the young, smooth coat emerges, in the form of a vesicle, and unites with the similar structure produced by a neighbouring cell. Al. Braun|||| thought it must be assumed, from Thwaites's observations, that

* Thwaites, Annals, xx. pl. 22. fig. c. Smith, *l. c.* pl. c. fig. 248.
† Smith, *l. c.* pl. c.
‡ *Ibid.* pl. D. fig. 246.
§ *Ibid.* pl. D. fig. 300.
|| *Ibid.* pl. E. fig. 353.
¶ *Ibid.* pl. E. fig. 353.
** Carter, Annals, 2 ser. xvii. pl. 1. fig. 17.
†† *Ibid.* fig. 23.
‡‡ Smith, *l. c.* pl. A. fig. 9. i.
§§ Thwaites, Annals, xix. Smith, *l. c.* pl. A.
|||| Al. Braun, Verjüngung, p. 305 (Translation, p. 285).

the primordial utricles of the two conjugating Diatomean cells united; but that this is not the case, and that a soft and flexible cell-membrane, protruded from the cracked, rigid, old shell, encloses the contents destined to be blended with those of the neighbouring cell, is distinctly shown by Smith's figure of *Rhabdonema arcuatum** and Carter's of *Cocconeis Pediculus*† and *Amphora ovalis*. The introductory part of the conjugation is distinguished in no respect from the vegetative cell-division in *Epithemia Sorex, Amphora ovalis* and *Cymbella Pediculus*, and, further, in *Closterium rostratum*;—in *Epithemia turgida, gibba*, and *verrucosa*, only by a different position of the wall dividing the mother-cell; in the rest of the Diatomeæ and Desmidieæ, by omission of the formation of septa; frequently, also, by one-sided dehiscence of the cracked mother-cell, whose shells remain still connected at one side.

Thwaites's observations established that the cell produced from the conjugation of two cells of a Diatomacean, very soon after its origin assumed the form of the mother-cell, becoming distinguishable from it almost solely by being twice as large. Smith has endeavoured to render it probable that the colonies of young individuals, enclosed in a cyst, of *Cocconeis Cistula, Gomphonema dichotomum* and *Synedra radians*, some of which he found associated with conjugated, full-grown individuals ‡, must have originated from the division of the spores (sporanges of English authors). This hypothesis has much in its favour, but in the present condition of our knowledge, it is inexplicable where the siliceous shells of the spore-cells remain. However this may be, there is no doubt of the occurrence of cysts of this kind. In the same pools of a marshy meadow which repeatedly furnished me with conjugated individuals of *Cyclotella* late in autumn, I found in early spring of two successive years globular cells, each of which enclosed a great number (32 to 40) of small individuals of the same species. The walls of these cells appeared sharply defined internally and externally; the contents of a thin, fluid nature. Structures similar to those represented by Smith, of *Synedra radians*, occurred in extreme abundance in the end of the autumn of 1854, in company with *Synedra Ulna*. Here the cells, which, like those observed by Smith in the allied species, had a diseased aspect and an abnormal arrangement of the coloured contents, were imbedded in a granular jelly, of a reddish colour by transmitted light. I very much doubt whether these last were in a condition capable of further development; while in reference to the cysts of *Cyclotella operculata*, I share Smith's opinion.

* Smith, *l. c.* pl. E. fig. 305.

† Annals, ser. 2. xvii. pl. 1. fig. 2.

‡ Brit. Diatomaceæ, ii. pl. B. C.

The establishment of the assertion that the commencement of conjugation in the Desmidieæ and Diatomeæ is but little distinguished from the commencement of vegetative cell-division, renders some discussion of the latter requisite. Pringsheim* has already directed attention to the resemblance of this process in the Desmidieæ to the vegetative cell-multiplication of the joints of *Œdogonium.* In fact, it is an absolutely general phænomenon in the true Desmidieæ, so far as observation reaches, that the older parts of the membrane of a cell about to divide, do not, as in other cases (for example, in Zygnemeæ), regularly increase in size with the parent-cell by growth in all directions; but the older, outer layers of the integument split open with an annular crack at the equator of the cell, shortly after (or during?) the division. They still remain sticking on, covering the ends of the cell with a thick envelope, but become removed gradually further apart by the interposition of new cellulose between their fractured edges. The interposed new coat is the direct continuation of that which lines the internal surface of the cracked halves of the old shell. It is the margins of the half-shells which constitute the rings, parallel to the end-surfaces, upon the cylindrical lateral surfaces of the cells of *Hyalotheca dissiliens* and *mucosa,* the wrinkled projections of the membrane in the middle of the deep constriction of the cell of *Micrasterias* and the large *Euastra,* of the flat constriction of the cell of *Docidium,* as also the ring at the equator of the external surface of *Closterium*: in *Closterium* and in *Docidium,* frequently as many as six may be counted,—a phænomenon which, in *Docidium truncatum* and the large *Closteria,* may be recognized at first sight as dependent upon a number of halves of cracked cells regularly encasing their successors.

The dehiscence of the coat of the dividing cell is, in all observed cases, preceded by the formation of the septum dividing the cell into two halves (fig. 30, *Cosmarium margaritiferum*). The gradual development of this from the margin of the cell-wall inwards as a gradually-widening, annular fold of the innermost layer of the integument, has not yet been observed, and, from analogy with the processes in *Œdogonium,* is scarcely probable†. But, as in *Œdogonium,* the contents of the cell may

* Pringsheim, Pflanzenzelle, p. 38, note.

† In judging of the equivocal appearances in the cell-division of *Œdogonium,* it seems to me of slight importance that the pellicular coat of the contracted, already-divided contents of the cell which has not dehisced, does not acquire a blue colour when treated with the iodized chloride-of-zinc solution, or with sulphuric acid and tincture of iodine. It is more than probable that the cellulose is not secreted by the cell-contents in lamellæ of firm substance, but as a semifluid substance; that in this latter state of aggregation it does not take a blue colour with iodine. I men-

be contracted, before the formation of the septum, into two masses, in contact, but separated by a sharp line of demarcation (two contracted daughter-cells imperfectly cut off from one another, still adhering together at the place of constriction; fig. 23, *Docidium truncatum*).

tioned above that the youngest part of the cell-wall of *Docidia* beginning to divide does not become blue by the action of iodized chloride of zinc, while the old shells acquire this colour. Far greater weight must be laid on the answer to the question whether the annular deposit of cellulose substance which appears a considerable time before the division at the upper end, in the internal wall, of the cell about to divide, subsequently invests, as a single cellulose membrane, the contents emerging from the crack of the dehiscent cell (De Bary's view, Abhandl. Senckenb. Gesells. i. p. 41, an opinion which Mohl has adopted; Bot. Zeitung, 1855, p. 720); or whether it becomes merely an investing envelope for the already existing proper membrane of the emerging daughter-cells, and is "the local deposit of a substance between the mother-cell and the uppermost daughter-cell" (Pringsheim, Pflanzenzelle, pp. 35, 42). From the first view, it would follow necessarily that the segments of contents of *Œdogonium*-cells undergoing division, contracting upon the addition of fluids which act exosmotically, are naked—are entirely destitute of a cell-membrane, even in a semi-fluid condition. Observations of the completed conditions scarcely allow of a certain decision whether the extruded mass of the ring now converted into a membrane, merely adheres to the dehisced old cell-wall, or whether it is immediately continuous with the innermost layer of the latter. But the appearances during the development all speak in favour of Pringsheim's view. The ring of cellulose in question has nothing in common with the infolding of the youngest layer of membrane in the dividing cells of *Cladophora*. Not only does it present itself in quite a different place from the septum,—its structure has no similarity whatever to that of an annular fold of a membrane. It may be seen distinctly, that as the old halves of the wall of the mother-cell gradually separate, the ring of cellulose is stretched out, like a piece of dough. It is not in any way unfolded, but stretched out lengthways in its whole mass. It is thickest in the middle between the margin of the separated pieces of the old cell-wall; by degrees, as the longitudinal extension increases, its thickness is brought down here also to that which it has at the points of junction with the old cell-membrane. The adhesion of the ring to the internal surface of the old cell-wall at the place of dehiscence, sufficiently explains the cohesion of the joints of the filament during the division. The comparison drawn by Pringsheim between this and the gelatinous substance which envelopes other Algæ, thus appears warranted. The resemblance between its development and extension with the completion of the thick gelatinous layer enveloping the whole filaments of *Hyalotheca* and *Didymoprium*, in cell-division, is at once evident.

[Our observations are in favour of the view of Von Mohl and De Bary. We believe that the thick ring of cellulose stretches out to form the first coat of the new cell. With regard to the blue colour taken by the young layers of cellulose in *Œdogonium*, we find there the *youngest most sensitive* to this reagent. The last-formed layer in perfect cells becomes blue when older layers do not; and even the extremely delicate globular vesicle which encloses the zoospore when it first emerges from a dehiscing cell, is coloured blue by sulphuric acid and iodine. This membrane is so extremely delicate, that it vanishes (by solution?) very soon after it is exposed externally, thus setting the zoospore free.—A. H.]

From the half-shells of cells of the same *Docidium* which dehisced under the eye of the observer, emerged, within half-an-hour, to the extent of $\frac{1}{5}$th or $\frac{1}{4}$th of the length of the half-shells, the daughter-cells, still intimately connected at the point of contact. They could henceforth be perceived to be enclosed by a cellulose coat, firm although delicate. Treated with reagents strongly extracting water, such as glycerine, one or both of the extruded pieces frequently drew back into the halves of the shells of the mother-cell, the projecting pieces of membrane becoming doubled inwards (fig. 24). The just-emerged coats of the daughter-cells of *Docidium* did not take a blue colour when treated with iodized chloride of zinc, while the old halves of the membrane of the divided cell assumed the blue colour immediately.

In *Cosmarium margaritiferum* (figs. 29, 30) and *Staurastrum dejectum*, it may be easily observed that a slight elongation of the isthmus, and the formation of a septum passing across the middle of this, precedes the appearance of new half-cells in the deep constriction. It is after the appearance of the septum that the old wall of the mother-cell breaks by an annular fissure exactly at the place where that septum is formed. The two halves of the old cell-coat are then separated by the bulging-out of the younger, inner layers of membrane, not firmly adherent to the old portions. The new halves are at first lined only by protruded portions of the pellicle of their contents (outermost layer of the parietal coats of protoplasm) belonging to the older half-cells; from the moment only of the dehiscence of the old cell-coat, does a portion of the granular contents of the older cell-halves make its way into the new emerging halves.

In like manner, doubtless, occurs the cell-division of *Micrasterias*, of the large forms of *Euastrum*, *Cosmarium*, *Staurastrum*, and other Desmidieæ, only that they have not been observed completely, because these larger Desmidieæ very seldom multiply by division out of the natural stations. The cell-division of the Diatomeæ that have hitherto been observed in vegetative multiplication, differs in essential points from that just described.

When a cell of *Navicula* (*Pinnularia*) *viridis* is about to divide, there appears upon one of the secondary sides (front view of English authors), parallel to the primary sides (the furrowed faces of the cell having an elongated elliptical outline), an annular rim, which, growing gradually inwards, constricts the contents of the cell by an annular furrow, in a manner exactly similar to that of the commencement of cross-division in a cell of *Cladophora*. When a cell in this state is treated with substances producing slight endosmosis (for instance, a

weak solution of carbonate of ammonia), the contents retract on both sides from the annular rim, and constitute two completely separate cell-like structures (halves of a primordial utricle), each of a very long ellipsoidal form, and each lying close against one of the primary sides (*faces* of halves) of the cell (fig. 31). When the annular rim has grown inwards to about the sixth part of the shortest diameter of the cell, its development is arrested. In natural conditions, this stage is succeeded by the retraction of the primordial utricle from it. Each of these halves of the cell-contents becomes clothed, on the side turned away from the primary side of the cell, with a new membrane (figs. 32, 33), which soon exhibits the first indications of the peculiar thickening ribs and nodules of one of the primary sides of our *Pinnularia*. The cell has now completed its division. Seen from one of the secondary sides, it contains two new individuals, equal to the mother-cell in length and breadth, but only possessing one-third of its thickness. The externally-situated primary side of each of them is the old primary side of the mother-cell, to which we must imagine the newly-formed membrane of the daughter-cell closely adherent at all points. Perhaps the narrow secondary sides of the new cells may be in the same condition. But the contiguous primary sides of the daughter-cells are totally new structures, which, developed rapidly, in a short time become similar to the old primary sides in every part. The two daughter-cells are at first held together by the broad, middle piece of the secondary sides of the mother-cell, bearing the above-mentioned annular rim inside. The contents of the intermediate space consist of a transparent fluid destitute of any solid structures, doubtless pure water. The two daughter-cells are finally set free by the gradual 'weathering' of the zone-membrane which holds them together. The division of *Surirella bifrons* takes place exactly in the same way. An essentially similar kind of vegetative multiplication is widely diffused, if not general, in the Diatomeæ. The well-known phænomenon of the formation of a tubular membrane, often impregnated with silex, and elegantly dotted or areolated, connecting the two segments of *Isthmia, Melosira*, &c., depends upon the same process*.

An analogous case is met with in the formation of the spores of *Pellia epiphylla*. The mother-cell here produces six ridges of

* [The author speaks of the annular 'rim' as if it were a product of the wall of the parent cell. It is rather a new product, formed in the interval between the two valves which have separated at the suture (somewhat as happens in *Œdogonium*). According to the degree to which the valves separate, the intermediate piece is a slender 'hoop,' as in *Navicula*, or a long tubular piece, as in *Melosira*, &c.—A. H.]

cellulose projecting inward from the internal wall, intersecting at an angle of 60°; these ridges grow in toward the middle point of the cell, like the annular ridge of *Cladophora* at the commencement of cell-division. When these projecting ridges have attained the breadth of a fourth part of the transverse diameter of the mother-cell, the cell-contents divide into four parts, which, retracting from one another and from those ridges, occupy the four chambers of the cell, each of which is vaulted externally and bounded laterally by three of the ridges,—here becoming coated with a membrane and developed into a spore, while the tetrahedral space in the middle of the cell, bounded by the six ridges, remains filled only with watery fluid*. The spores become free by the solution of the enveloping part of the membrane of the mother-cell. The resemblance of this process to the vegetative multiplication of *Navicula* consists in the interruption of the division of the cell by the formation of septa, and the subsequent completion of the daughter-cells by secretion of membrane on the external surface of contracted portions of the contents of the mother-cell. A deviation occurs in the circumstance that in *Pellia* the segment of the coat of the mother-cell which is in contact with the external surface of the daughter-cell becomes dissolved, while in *Navicula* it persists and remains most intimately connected with the daughter-cell.

The newly-formed parts of the cell-coat facing together in the division, are in the Diatomeæ, and still more clearly in the Desmidieæ, perfectly smooth and even for some time after their production; it is subsequently that they obtain the often very considerable tubercles and spines, consisting principally of cellulose. The same applies to the processes upon the outer integument of the spores of *Euastra, Cosmaria* and *Staurastra* produced in the conjugation. These phænomena, as also the autumnal secretion of jelly by many of the Desmidieæ, deserve more notice than they have hitherto attracted in connexion with the theory of the life of the vegetable cell. Still more remarkable behaviour is displayed by the cell-coat of an organism which I refer only doubtfully to the Desmidieæ. In many pools about Leipsic, in which Desmidieæ abounded, occurred large, accurately spherical, thick-walled cells, some as much as ·05 millim. in diameter, rich in chlorophyll, which not only lined the internal wall as a connected granular layer, but—as in many Desmidieæ—formed groups, distributed, in the interior of the cell, in a system of radially arranged plates, which presented a stellate appearance

* Hofmeister, Vergleich. Untersuch. p. 20. [This is apparently common in the spore-formation of Hepaticæ: we have observed it in *Marchantia*.—A. H.]

when seen from the side (fig. 28). It would be no great stretch of imagination to regard these cells as the conjugation-spores of a large Desmidiean. But these spores are all spiny, with the single exception of those of *Xanthidium armatum*. This very striking form occurs but rarely with us, having hitherto been found only in a single locality, while these globules are as common as they are abundant, and are often found in great numbers in forest pools, which harbour, in addition to them, only very small Desmidieæ. But such a supposition is still more decidedly negatived by the circumstance that the cells in question are sometimes found dividing into two (fig. 29). This renders it in the highest degree probable that they are independent organisms,—Desmidieæ without a central constriction, which may form the commencement of a series of forms terminating in *Micrasterias*.

These cells frequently appear surrounded by a wider coat, inside which the cell then floats freely, enclosed by its own closely investing coat (figs. 26, 27). Several such empty coats are often met with, even as many as six sticking one inside another. Close investigation shows that the broader empty coats have an orifice, towards the border of which the membrane grows gradually thinner. These holes have not the aspect of perforations of the outer walls through external injury; they rather resemble the orifices of the walls of *Cladophora*, through which the swarming-spores escape. It might be conjectured that the plant multiplied by swarming-spores, and that solitary ones becoming developed inside the empty coat of the mother-cell gave rise to that appearance. But this is contradicted by the great frequency of their occurrence, as also by the circumstance that we never find a number of green cells inside one cell-coat. It is more probable that the contents of the cell contract, and become coated with a new membrane, when the old one is perforated,—by unknown causes, which perhaps lie in the course of development of the species.

If we seek to bring the phænomena introductory to vegetative cell-multiplication under one point of view with the preparations for conjugation, we find that, in the Desmidieæ, in both cases a new membrane is formed around the total contents of the cell, which indeed lies close upon the old coat at all points, but by no means adheres to it, as we are accustomed to conceive of the so-called layers of thickening of the cell-wall. The growth of the young membrane cracks the stronger old one—in vegetative cell-multiplication always in an annular form, in conjugation mostly in a one-sided manner, with a valve-like slit (*Hyalotheca dissiliens*, figs. 5–8; *Closterium*, fig. 10). At this stage first occurs a distinction between the two processes of development—

the formation of a septum taking place in cell-division, while in conjugation the protruding part of the young membrane continues to enlarge outwards without, in many cases, any separation of the contents into two halves taking place. The younger innermost layer of membrane remains with that portion lining the old cell-coat, sticking wholly in this in *Hyalotheca, Bambusina, Cosmarium.* But even in individuals of species of the last genus it sometimes occurs, in *Tetmemorus, Closterium* (e. g. *C. acutum,* fig. 10), as a rule (although by no means without exception), that the ends of the connected inner coats of the conjugating cells draw themselves out of the cast-off shells of the mother-cells, in extreme cases entirely; so that the cell originating by the blending of the internal coats of two individuals (inside which the spore is formed) becomes capable of being rounded-off into a sphere.

Both the cell-division and the preparation for conjugation of Zygnemeæ are distinguished from the processes in Desmidieæ, by the circumstance, that in the former the wall of the oldest cells grows in its entire mass, and does not allow the younger layers of membrane to protrude through fissures or slits.

In the Diatomeæ, lastly, the division into two, like the conjugation, takes place, seemingly in all cases, through and after a preparatory contraction of the contents or separate portions of the contents of the cells; and in not a few cases the conjugation takes place during, and is accompanied by, division of the contracted contents into two portions. What import for the life of the species has the conjugation of the Zygnemeæ, Desmidieæ, Palmelleæ (*Palmoglœa*), and Desmidieæ? Our knowledge of the race of Algæ, so importantly advanced by the labours of Pringsheim and Cohn, should allow a more positive answer to this question than that inquirer*, to whom the study owes most brilliant acquisitions, is inclined to give. The idea of sexuality of the lower Algæ depends principally upon the perfectly justifiable but still only analogical conclusions, which, starting from the observations made during a century on the Phanerogamia, have advanced, through the intermediation of those less numerous on the Vascular Cryptogamia and Muscineæ, and the facts established in *Fucus* by experiment of artificial separation or union of the sexes, to the *Œdogonia, Vaucheria, Sphæroplea* and *Volvox*. Pringsheim's declaration, that physiological questions of such kind as the necessity of the action of the fecundating matter in generation can only be certainly decided by the observation of morphological processes,—will not be adopted. Experiment has long ago proved the existence of sexes in the Phanerogamia,

* Pringsheim zur Kritik u. Geschichte der Unt. ueber Algen-geschl. Berlin, 1857, p. 15.

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before the penetration of the pollen-tube into the ovule, and its relation to the germinal vesicle, had been made out;—observations which that theory really no longer required for the establishment of its main question. And if among so many confirmatory experiments, a few negative results present themselves —in what branch of human knowledge do we not meet with similar phænomena? The general rules of evidence hold good in such cases.

The same analogies, then, which lead us to recognize a fecundation in the penetration of the spermatic body of *Œdogonium* into the mother-cell of the spore, in the mixture of that body with the contracted contents of the mother-cell of the spore (with Pringsheim's 'fecundation-globule'), must necessarily lead us to regard conjugation as a fecundation. It is distinguished from the process in *Œdogonium* only by the fact that the portions of cell-contents which become blended into one cell are of equal size, and that there is not one of them provided with apparatus by means of which, like the spermatic body of *Œdogonium* by its cilia, it is moved onward until it reaches the cell to be fecundated;—both points, evidently, of no essential importance.

EXPLANATION OF PLATE I.

Fig. 1. *Cosmarium tetraophthalmum,* at the commencement of conjugation. Magnified 300 diameters, like the succeeding figures.

Fig. 2. Two individuals of the same *Cosmarium* in conjugation.

Fig. 3. Spore of the same *Cosmarium,* after the spiny outer coat has been stripped off. The contents of the spore divided into two primordial cells.

Fig. 4. A spore treated in the same way in the succeeding spring, dehiscent. Two of the daughter-individuals have escaped from the crack.

Fig. 5. Cells of *Hyalotheca dissiliens,* just conjugated. The borders of the old cell-coat may be detected on the gaping halves of the right-hand cell.

Figs. 6, 7, 8. Conjugated cells of the same plant, after the formation of spores.

Fig. 9. Minute *Closterium* (perhaps identical with *Rhaphidium*), which, like the *Palmoglœa* represented in figs. 11–22, occurred in thousands on the surface of water in vessels used for the cultivation of large water-plants. The cells entering into conjugation show very clearly the extrication of the conjugation-cell from the old shell. Magn. 500 diameters.

Fig. 10. *Closterium acutum* in conjugation: from a preparation in dilute glycerine. Magn. 500 diameters.

Figs. 11–17. *Palmoglœa,* sp. in different stages of division; fig. 16, treated with tincture of iodine; fig. 17, after keeping in glycerine. Magn. 400 diameters.

Figs. 18–22. The same *Palmoglœa,* in different stages of conjugation; fig. 22. conjugation of three individuals (from objects kept in glycerine).

Fig. 23. *Docidium truncatum*; an individual about to divide, treated with solution of carbonate of ammonia.

Fig. 24. Recently-divided individual of the same species, laid in glycerine. The protruded new membrane of one half (the contents of which are drawn) has become doubled-in by the action of the fluid extracting water. The thin, gelatinous envelope which surrounded the old halves appears more clearly than in specimens lying in water.

Fig. 25. One-half of a similar object, treated with carbonate of ammonia. Only the outlines of the contracted cell-contents are given.

Figs. 26, 27. Globular cells surrounded by a double coat, occurring frequently among small Desmidieæ, after having been kept a long time in glycerine.

Fig. 28. One of the same with a simple coat; a fresh specimen.

Fig. 29. Two cells produced by the division of one of these cells, adhering together at the flattened surface of contact.

Fig. 30. Outline sketch of a *Cosmarium margaritiferum* beginning to divide.

Fig. 30 *b*. The isthmus of this cell more magnified.

Fig. 31. *Navicula viridis* at the commencement of division.

Figs. 32, 33. The same plant in more advanced stages of division. The striæ of the primary sides, indications of which were already visible, in fig. 33, in the newly-formed adjacent sides of the daughter-cells, are omitted, in order to leave the drawing clearer.

II.—*Brief Diagnostic Characters of undescribed Madeiran Insects.* By T. Vernon Wollaston, M.A., F.L.S.

[With two Plates.]

Ordo COLEOPTERA.

Fam. CARABIDÆ.

Genus Calathus, Bon.

Calathus fimbriatus.

C. apterus, latiusculus, *C. complanato* plerumque paulo brevior, valde depressus, piceus, prothorace latiusculo, antennis pedibusque ferrugineis.

Mas nitidus; tibiis posterioribus intus (præsertim versus apicem) pilis longis densissime fimbriatis.

Fœm. opacus; tibiis fere simplicibus.

Calathus complanatus, var. γ, Ins. Mad. 30 (1854).

Inhabits Porto Santo, abounding beneath stones (principally in the lower districts), and being apparently the Porto-Santan representative of the *C. complanatus* of Madeira proper and the Dezertas. Although attention was called, in the 'Insecta Maderensia,' to the present *Calathus*—as being considerably flatter, and rather broader and shorter than the ordinary *C. complanatus*

of Madeira proper and the Dezertas (as well as to the greater opacity of its male sex, and the more shining surface of the female),—it is not until now that I have ventured to regard it as specifically distinct; and it is through the detection by Mr. Janson of a good, *structural* character, which cannot possibly be the result of any combination of local influences to which it may have been long exposed in the more remote island of Porto Santo, that I would without hesitation, in the present paper, propose for it a new name. The peculiarity above alluded to (to which Mr. Janson has lately directed my attention) is a most remarkable one; nevertheless it had entirely escaped my own observation hitherto. It consists in the fact of the four hinder tibiæ of the males being densely fringed with long and very robust hairs along the apical two-thirds of their inner edge. It is a character which is most anomalous for the *Calathi*, and one which cannot fail therefore to strike every Coleopterist as abundantly sufficient, even of itself, to establish a specific claim; but when it is viewed in conjunction with the other differences, of outline and form, long ago alluded to, the *C. fimbriatus* may be at once looked upon as a most interesting addition to the *Geodephaga* of the Madeiran group. And I may add, moreover, that it is a most important consideration (and one which tends directly to substantiate the validity of other species, somewhat similarly circumstanced, and concerning which I have expressed occasional doubt,—such as, for instance, the *Hadrus illotus*), that so abundant and universal an insect as is the *C. complanatus* throughout Madeira proper and the Dezertas, *should have a strictly representative species,* and equally common, in the more distant island of Porto Santo.

Genus Trechus, Clairv.

Trechus Jansonianus.

T. subovato-oblongus, angustatus, fusco-piceus, nitidus; prothorace parvo, subcordato, in disco parum convexo, basi utrinque leviter impresso, angulis posticis subrotundatis; elytris abbreviatis (pygidio multo brevioribus), lævibus (striarum fere carentibus), versus latera necnon ante apicem paulo dilutioribus; antennis testaceis, breviusculis, valde robustis; pedibus pallido-testaceis.—Long. corp. $1\frac{1}{3}$ lin.

Several specimens of the present very interesting little *Trechus* were discovered by Mr. Janson (to whom I have dedicated the species) amongst the refuse which had accumulated around some blocks of a trunk of a Dragon-tree brought from Madeira proper by Mr. Mason. In general affinity (and probably also in habits) it is closely allied to the *T. fimicola;* nevertheless it is altogether

narrower, and less ovate, than that insect; its prothorax is distinctly smaller, more convex on the disk, and more evidently impressed (transversely) behind; its elytra are very much shorter (a considerable portion of the pygidium being exposed to view), and still more free from indications of longitudinal striæ; its antennæ are even more robust than is there the case; and its entire colouring (as will be perceived from the above diagnosis) is different.

It may perhaps be desirable to state, that besides the two foregoing additions to the Madeiran Coleoptera since the publication of the late corrected Catalogue for the British Museum, I have detected amongst the insects of Mr. Bewicke the common *Alphitobius mauritanicus*,—which I had accidentally overlooked amongst some specimens of the *A. diaperinus* which he had formerly given me. Like that insect, it has been clearly introduced, with stores, into those islands; and it is therefore of no great importance. Still, in conjunction with the two above described, it raises the hitherto-detected species of Madeiran Coleoptera (from 580) to 583. Its synonymy appears to be as follows:—

Alphitobius mauritanicus.

Tenebrio mauritanicus, Fab. [nec. Linn. 1767] Ent. Syst. i. 113 (1792).
Tenebrio Fagi, Pnz. Fna Ins. Germ. 61. 3 (1799).
Tenebrio mauritanicus, Fab. Syst. Eleu. i. 149 (1801).
Tenebrio Fagi, Sturm, Deutsch. Fna, ii. 233 (1807).
Tenebrio Fagi, Dufts. Fna Austr. ii. 303 (1812).
Alphitobius picipes, Steph. Ill. Brit. Ent. v. 11 (1833).
Heterophaga mauritanica, Dej. Cat. edit. 3. 220 (1837).
Heterophaga mauritanica, Lucas, Col. de l'Algérie, 341 (1849).
Heterophaga Fagi, Redt. Fna Austr. 594 (1849).

The points in which it differs from the *A. diaperinus* may be at once gathered by a reference to page 499 of the 'Insecta Maderensia.'

Ordo ORTHOPTERA.

Fam. FORFICULIDÆ.

Genus Forficula, Linn.

Forficula edentula.

F. aptera, valde depressa, fusco-ferruginea vel fusco-picea, glabra, subopaca; capite postice paulo dilutiore; prothorace subquadrato, ad latera pallidiore, subdiaphano; elytris valde abbreviatis, apice conjunctim profunde emarginatis; abdomine confertim subrugulose-punctato, segmentis secundo et tertio plica laterali auctis, ultimo fere simplici, in fœm. apicem versus distincte sed parce pilosis; forcipis cruribus in utroque sexu edentulis, in ♂ longioribus,

curvatioribus; antennis (13-articulatis), palpis pedibusque diluto-testaceis, plus minus infuscatis.

Long. corp. ♂ $4\frac{1}{2}$–$5\frac{1}{2}$ lin.; forc. 2–$2\frac{1}{3}$ lin.
„ „ ♀ $4\frac{1}{2}$–6 lin.; forc. $1\frac{1}{2}$–vix 2 lin.

Inhabits Madeira proper, occurring in the moist sylvan districts of intermediate altitudes; detected by myself at the base of the lofty perpendicular rocks near the upper extremity of the Ribeira de S[ta] Luzia, during July 1855. It is a truly indigenous *Forficula*, and of a very remarkable type,—its apterous body, much abbreviated (apically-emarginate) elytra, and sub-opake, greatly flattened surface, in conjunction with the total freedom of even its *male* forceps from internal teeth, giving it a character which it is impossible to mistake.

Fam. BLATTIDÆ.

Genus Blatta, Linn.

Blatta Ericetorum.

B. nitida, nigra, limbo late elytrorumque sutura anguste pallidis, subdiaphanis; capite vel omnino vel solum hinc inde pallido; prothoracis dorso nunc vix nunc distinctius dilutiore, interdum etiam prothorace toto pallido; elytris modo abdominis longitudine, modo paulo longioribus; alis minutis, fere obsoletis; antennis palpisque ad basin pallidis, apicem versus obscurioribus; pedibus vel omnino pallidis, vel ad apicem ipsum tarsorum tibiarumque (valde spinosarum) nigrescentibus.—Long. corp. $4\frac{1}{2}$–$5\frac{1}{2}$ lin.

Inhabits Madeira proper, occurring principally beneath the loose outer fibre of the gigantic Heath-trees, on the upper limits of the sylvan districts,—from about 4500 to 5000 feet above the sea. It has been examined by Dr. Fischer of Friburg, who regards it as new, though allied to the *B. marginata* of Southern Europe.

Ordo HYMENOPTERA.

(Sectio I. Terebrantia.)

Fam. ICHNEUMONIDÆ.

Genus Misoleptus, Grav.

Misoleptus Maderensis. Pl. IV. fig. 1.

M. mas testaceus; capite antennisque nigris, his corporis longitudine; thorace fascia fusca, lateribus antice albidis; abdomine piceo, fasciis pedibusque testaceis; alis subhyalinis.—Long. corp. $1\frac{1}{2}$, alar. $2\frac{1}{2}$ lin.

Inhabits Madeira proper; having been discovered by myself

in the dense forest-region of the Lombo dos Pecegueiros, in the north of the island.

Genus HEMITELES, Grav.

Hemiteles postica.

H. fœm. nigra, nitens; antennis corpore paulo brevioribus; abdomine rufo, basi nigro; oviductu abdominis dimidio paulo breviore; pedibus rufis, nigro-variis; alis subhyalinis.—Long. corp. 2, alar. 3½ lin.

Inhabits Madeira proper.

Genus EXETASTES, Grav.

Exetastes peregrinus. Pl. IV. fig. 2.

E. mas niger; antennis corpore paulo brevioribus; abdomine valde compresso, thoracis duplicati longitudine, segmentis 3tio 4toque flavis; pedibus flavis, femoribus tarsisque posticis nigris; alis subhyalinis.—Long. corp. 2–5, alar. 5–7 lin.

Inhabits Madeira proper, occurring principally at lofty elevations. In August 1850, I captured it on the extreme summit of the Pico Ruivo,—more than 6000 feet above the sea.

Genus EPHIALTES, Grav.

Ephialtes lateralis. Pl. IV. fig. 3.

E. fœm. niger; antennis corporis dimidio paulo longioribus; thoracis vittis lateralibus coxisque anterioribus flavis; abdomine ferrugineo-rufo, thorace plus duplo longiore, basi suturisque nigris; oviductu corporis longitudine; pedibus rufis; alis hyalinis.—Long. corp. 6–8, alar. 9–19 lin.

Inhabits Madeira proper; occurring in the moist sylvan districts (Cruzinhas, Pecegueiros, &c.) of intermediate and lofty altitudes.

Prithous *Ephialtes lineatus.* Pl. IV. fig. 4.

E. fœm. rufus; capite flavo, nigro-vario; antennis nigris subtus ferrugineis, corporis dimidio longioribus; thorace nigro flavoque vittato; abdomine thorace plus duplo longiore, suturis nigris; oviductu abdominis dimidio paulo breviore; pedibus luteis, posticis nigro-variis; alis hyalinis.—Long. corp. 5, alar. 7½ lin.

Inhabits Madeira proper; being attached to similar spots (Cruzinhas, &c.) as the last species, within the sylvan regions.

Prithor- *Ephialtes linearis.*

E. mas et *fœm.* rufus; capite antennisque nigris, his corpore bre-

vioribus; thorace nigro-vario; oviductu abdominis dimidio multo breviore; pedibus fulvis, tibiis posticis tarsisque apice nigris; alis hyalinis.—Long. corp. maris 2–2½, fœm. 4½ lin.: alar. maris 2½–3½, fœm. 6 lin.

Inhabits Madeira proper, in similar localities (Ribeiro Frio, &c.) as the last two species.

Genus Lissonota, Grav.

Lissonota dorsalis. Pl. IV. fig. 5. is a [illegible]

L. mas nigra; antennis corpore paulo brevioribus; mesothorace rufo, macula nigra ornato; abdominis suturis ferrugineis; pedibus rufis, tibiis posticis nigris; alis subcinereis, areola discali tetragona. —Long. corp. 2½–3½, alar. 4–6 lin.

Inhabits Madeira proper, occurring in sylvan spots (Cruzinhas, Ribeiro Frio, Sta Anna, &c.) of intermediate and lofty elevations.

Genus Bassus, Grav.

Bassus albovarius.

B. niger; antennis corpore multo brevioribus; scutello albo-maculato; pedibus rufis, tibiis posticis albo nigroque fasciatis, tarsis posticis nigris; alis hyalinis.—Long. corp. 2, alar. 3½ lin.

Inhabits Madeira proper.

Fam. BRACONIDÆ.

Genus Perilitus, Nees von Es.

Perilitus debilis. Pl. IV. fig. 6.

P. fœm. testaceus; antennis nigris; thorace piceo-trivittato; petiolo brevi; oviductu abdominis dimidio longiore; alis hyalinis.—Long. corp. 1½, alar. 2½ lin.

Inhabits Madeira proper; detected by myself in the chestnut-woods of Sta Anna, during the summer of 1850.

Genus Euphorus, Nees von Es.

Euphorus petiolatus.

E. mas et *fœm.* testaceus; antennis fuscis; mesothorace nigro; petiolo fusco, basi albido, abdominis longitudine; oviductu subexserto; alis hyalinis.—Long. corp. 1½–1¾, alar. 2½–3 lin.

Inhabits Madeira proper; captured in the same locality as the last species.

Genus Ascogaster, Wesm.

Ascogaster maculata.

A. mas nigra; capite thoraceque ferrugineo-variis; antennis setaceis, basi ferrugineis, corpore vix brevioribus; abdomine striato, thorace paulo longiore et latiore; pedibus ferrugineis, tibiis et tarsis posterioribus fuscis, illis albido-cinctis; alis anticis subnebulosis, albido-unimaculatis.—Long. corp. $1\frac{1}{2}$, alar. $2\frac{1}{2}$ lin.

Inhabits Madeira proper; having been captured by myself on the extreme summit of the Pico Ruivo (upwards of 6000 feet above the sea), early in August 1850.

Genus Rogas, Nees von Es.

Rogas rufo-ater.

R. mas niger, punctatus; antennis corpore paulo brevioribus; metathorace ruguloso, subquadrato, carinato; abdomine rufo, apice nigro, fasciis cinereis ornato; alis subfuscis.—Long. corp. 3, alar. $4\frac{1}{2}$ lin.

Inhabits Madeira and Porto Santo; being tolerably common in the north of the former, especially in the chestnut-woods around Santa Anna.

Fam. DIAPRIADÆ.

Genus Clinocentrus, Hal.

Clinocentrus anticus.

C. fœm. niger; antennis basi ferrugineis; scuto depresso substriato; mesothorace subcarinato; abdomine subsessili, subtus piceo, basi striato; oviductu brevi; pedibus ferrugineis; alis cinereis, maculis apud stigma albidis ornatis.—Long. corp. $2\frac{1}{2}$, alar. 5 lin.

Inhabits Madeira proper; having been captured by myself in the chestnut-woods of Santa Anna, during the summer of 1850.

Clinocentrus divisus.

C. fœm. fuscus; antennis basi testaceis, corpore paulo longioribus; thorace fusiformi, mesothorace ferrugineo punctato; abdomine longi-ovato, piceo-nigro, thorace paulo latiore vix longiore; oviductu abdominis longitudine; pedibus testaceis; alis hyalinis.—Long. corp. $\frac{3}{4}$, alar. $1\frac{1}{2}$ lin.

Inhabits Madeira proper; taken by myself in Funchal.

Genus Spathius, Nees von Es.

Spathius apterus.

S. fœm. fulvus, apterus, nitens, brevis; antennis fuscis, basi fulvis,

corpore paulo brevioribus; abdomine piceo, fusiformi, thorace latiore et paulo longiore; oviductu abdomine vix breviore.—Long. corp. $1\frac{1}{2}$ lin.

Inhabits Madeira proper; captured at São Vincente, in the north of the island.

Genus Galesus, Curt.

Galesus fissus.

G. fœm. niger; capite lineari, vix thoracis longitudine; antennis subclavatis, corporis dimidio haud longioribus; tibiis ferrugineis, tarsis testaceis; alis fuscis, apice fissis.—Long. corp. 2 lin.

Inhabits Madeira proper, occurring at intermediate (S. Antonio da Serra, Ribeira da Janella, Feijãa de Córte, &c.) and lofty elevations.

Fam. SCELIONIDÆ.

Genus Telenomus, Hal.

Telenomus basalis.

T. fœm. ater; capite thorace latiore; antennarum articulo primo pedibusque fulvis; abdomine basi striato; alis limpidis, apice vix fuscescentibus.—Long. corp. $\frac{1}{2}$, alar. $\frac{3}{4}$ lin.

Inhabits Madeira proper.

Telenomus subfasciatus.

T. fœm. ater, latus; capite thorace latiore; pedibus fulvis; abdomine punctato, basi striato; alis subhyalinis, sub stigmate indistincte fuscescentibus.—Long. corp. $\frac{2}{5}$, alar. $\frac{2}{3}$ lin.

Inhabits Madeira proper.

Telenomus divisus.

T. fœm. ater, subgracilis; capite thorace vix latiore; antennis ad basin pedibusque fulvis; abdomine punctato, basi striato; alis subfuscescentibus.—Long. corp. $\frac{1}{4}$, alar. $\frac{2}{5}$ lin.

Inhabits Madeira proper.

Telenomus Maderensis.

T. mas et *fœm.* niger, lævis, latus, punctatus, obscurus; antennis fulvis, apice nigris; abdomine nitente, brevi, basi subsulcato; pedibus fulvis; alis hyalinis.—Long. corp. $\frac{2}{3}$, alar. $1\frac{1}{4}$ lin.

Inhabits Madeira proper; taken in the chestnut-woods of Santa Anna, during the summer of 1850.

Telenomus flavicornis.

T. niger, latus, subnitens, scite punctatus; antennis flavis, basi nigris; abdomine piceo, basi sulcato; pedibus flavis; alis subfuscis.—Long. corp. ½, alar. 1 lin.

Inhabits Madeira proper; captured in the same locality as the last species.

Telenomus diversus.

T. fœm. piceus; capite rufo; antennis luteis, capitatis, basi nigris, corporis dimidio brevioribus; pedibus fulvis; alis albidis.—Long. corp. ½, alar. ⅘ lin.

Inhabits Madeira proper; taken in the same spot as the last two species.

Genus Scelio, Latr.

Scelio minor. Pl. IV. fig. 7.

S. mas et *fœm.* niger (*S. rugosulo* multo minor ac gracilior); antennis corporis dimidio maris multo longioribus, fœminæ multo brevioribus; abdomine maris basi pedibusque piceis; tibiis basi apiceque tarsisque testaceis; alis maris subhyalinis, fœminæ hyalinis.—Long. corp. 1, alar. 1½ lin.

Inhabits Madeira proper; detected in the chestnut-woods of Santa Anna, during the summer of 1850,—beneath stones, and crawling at the roots of grass on the dry ground.

Genus Ceraphron, Latr.

Ceraphron parvulum. Pl. IV. fig. 8.

C. fœm. nigrum, nitens, subgracile; antennis corpore paulo brevioribus; abdomine basi striato; pedibus fulvis; femoribus alisque fuscis.—Long. corp. ½, alar. ¾ lin.

Inhabits Madeira proper.

Fam. CHALCIDIDÆ.

Genus Pteromalus, Swed.

Pteromalus discalis.

P. fœm. cupreo-viridis, robustus; antennis nigris, basi testaceis; abdomine æneo-viridi, subfusiformi, thorace longiore, in disco nigro-purpureo; pedibus flavis, tibiis tarsisque anticis fulvis, tibiis posterioribus apice fuscis; alis hyalinis, macula magna discali fusca ornatis.—Long. corp. 1⅔, alar. 3 lin.

Inhabits Madeira proper; occurring in the sylvan districts (Lombo dos Pecegueiros, &c.) of intermediate altitudes.

Pteromalus biquadratus.

P. fœm. nigro-cupreus, brevis, latus; antennis nigris; abdomine breviter ovato, thoracis longitudine; tibiis fuscis, tarsis fulvis; alis subhyalinis, maculis quatuor magnis fuscis ornatis.—Long. corp. 1, alar. $1\frac{1}{2}$ lin.

Inhabits Madeira proper; captured at the Lombo dos Pecegueiros, with the last species.

Genus Coccophagus, Westw.

Coccophagus nigrifrons.

C. fœm. niger; antennis piceis, clavatis, corporis dimidio brevioribus; scutello flavo, apice nigro; abdomine nigro-æneo; femoribus nigris, tarsis anticis fulvis; alis hyalinis.—Long. corp. $\frac{1}{3}$, alar. $\frac{3}{4}$ lin.

Inhabits Madeira proper; taken at São Vincente and Santa Anna, in the north of the island, and at Funchal, in the south.

Genus Eulophus, Geoffr.

Eulophus marginalis.

E. fœm. cupreus; capite thoraceque antico viridibus; antennis nigris, clavatis, basi flavis, thorace brevioribus; abdomine elliptico, nigro-æneo, basi testaceo, apice æneo-viridi; pedibus testaceis; alis anticis subhyalinis, macula maxima subquadrata fusca ornatis.—Long. corp. $1\frac{1}{4}$–$1\frac{1}{3}$, alar. $2\frac{1}{4}$–$2\frac{1}{2}$ lin.

Inhabits Madeira proper; occurring in the sylvan districts (Cruzinhas, Lombo de Vaca, &c.) of intermediate and lofty altitudes.

(Sectio II. Aculeata.)

Fam. BETHYLIDÆ.

Genus Bethylus, Latr.

Bethylus linearis.

B. mas niger; capite punctatissimo, thorace multo latiore; antennis pedibusque testaceis, illis capite haud duplo longioribus; thorace capite duplicato multo breviore; abdomine elliptico, thorace latiore et paulo longiore; alis subfuscis.—Long. corp. $1\frac{1}{4}$–$1\frac{1}{2}$, alar. 2–$2\frac{1}{2}$ lin.

Inhabits Madeira proper, occurring at intermediate and lofty elevations;—Santa Anna, Lombo de Vaca, Fanal, &c.

Bethylus latus.

B. mas niger, præcedenti latior; capite punctatissimo, thorace multo

latiore; antennis pedibusque testaceis, illis apice fuscis, capite paulo longioribus; thorace capite paulo longiore; abdomine elliptico, thorace latiore et paulo longiore; alis subfuscis.—Long. corp. $1\frac{2}{3}$, alar. $2\frac{1}{2}$ lin.

Inhabits Madeira proper, principally at intermediate altitudes; —Santa Anna, Ribeiro Frio, &c.

Bethylus tenuis.

B. mas niger; capite oblongo, parce punctato, thorace vix latiore sed multo breviore; antennis testaceis, apice fuscis, capite longioribus; abdomine longi-elliptico, thorace latiore et paulo longiore; pedibus testaceis, femoribus partim piceis; alis anticis subrufescentibus.—Long. corp. $1\frac{1}{4}$–$1\frac{1}{3}$, alar. $1\frac{1}{2}$–$1\frac{3}{4}$ lin.

Inhabits the Northern Dezerta, or Ilheo Chão, on which I captured it abundantly early in June 1850, and at the end of May 1855.

[To be continued.]

III.—*Notice of two new species of* Brownia, *a genus of Oceanic Mollusca.* By Arthur Adams, F.L.S.

Hong Kong, Oct. 1, 1857.

On the 4th of July, steady breeze and fine weather, while crossing the China Sea, I was fortunate enough to take in the towing-net two new species of the genus *Brownia* of D'Orbigny. The typical species *B. Candei* is described as "lateraliter carinato-crenulata," and is probably the same as the *Echinospira diaphana* of Krohn, the *Calcarella spinosa* of Souleyet, and the *Jasonilla M'Leayiana* of Macdonald, all of which have the three salient angles of the whorls armed with short spines. In the species here described the whorls are unarmed, being carinated in one and angulated in the other. The forms described by Krohn, Souleyet, D'Orbigny, and Macdonald, may, however, be all distinct, forming a spinose section of the genus. Unfortunately the shells of my two species were found empty, with the exception of a transparent fragment in one individual of *B. carinata*, an examination of which, in conjunction with the form of the shell of these new species, has led me to infer, with M. D'Orbigny, that the animal is a Heteropod belonging to the family *Atlantidæ*, and not to the *Macgillivrayidæ*, where my brother and myself have placed the genus *Calcarella* of M. Souleyet. The shells are so perfectly diaphanous, that they are invisible in water, and were only detected by their adhering to the tongue of red bunting of the towing-net. D'Orbigny describes his *Brownia* as a section of the genus *Helicophlegma*, which is the same as the *Oxygyrus* of Benson and the *Ladas* of Cantraine.

When dried, one of my specimens shrivelled up and turned brown, in which state it certainly nearly resembled that genus. Krohn has fully described the animal of his *Echinospira diaphana* in the 'Archiv für Naturgeschichte' for 1855, but I am unable to give any account of his communication. There is a genus of plants called *Brownia,* but I have no means of ascertaining the priority.

Brownia carinata, A. Adams.

B. testa compressa, discoidea, cartilaginosa, tenui, pellucida, anfractibus vix 3, carinis tribus acutis prominentibus cingulatis; spira plano-concava; apertura rhomboidea; peristomate tenui, acuto, antice valde producto, lateraliter carinato.

Hab. China Sea; taken in the towing-net.

Brownia angulata, A. Adams.

B. testa discoidea, ventricosula, cartilaginosa, diaphana, tenui, anfractibus vix 3, angulis tribus subacutis cingulatis; spira plano-convexa; apertura rhomboidea; peristomate tenui, acuto, antice producto, lateraliter angulato.

Hab. China Sea; taken in the towing-net.

IV.—*On Specific Character, Fecundation, and Abnormal Development in* Œdogonium. By H. J. Carter, Esq., Assistant Surgeon H.C.S. Bombay.

[With a Plate.]

The object of the following observations is to point out means by which it is hoped the species of *Œdogonium* may be better distinguished; to confirm Prof. Pringsheim's discovery of the mode of impregnation in this genus; and to figure and describe an abnormal growth which takes place from the 'resting-spore.'

Having in vain tried to find out the species of *Œdogonium* which I have had under observation, among those which have been already published, whether from the meagreness of the descriptions and illustrations, or from their having actually been undescribed, while other characters than those already noticed have presented themselves to me, which are evidently more valuable for specific distinction, I have been induced not only to describe, but also to name, those which I have been studying; for whether or not described before, those descriptions and names alone will hereafter be found useful which serve for their identification.

The characters to which I allude are sexual, and therefore can

only be seen when the Alga is sporing, just as those which are most valuable in plants can only be seen when they are under inflorescence, which is a corresponding state. They consist in the presence of annular cells situated singly or in plurality between the ordinary cells, but with a constancy in their fixed or variable number which renders the species to which they belong always recognizable. Each annular cell developes one or more spermatozoids, and they may be on the same filaments as the spores, or on different ones. Thus the species may be monœcious or diœcious; while the interesting feature pointed out by Prof. Pringsheim in *Œdogonium ciliatum**, shows that one species at least propagates somewhat after the manner of some of the Cephalopoda, that is, by detaching a male organ or spore, which has to undergo a secondary development before the spermatozoids are produced. As yet, I have only met with one diœcious species, which, with two other monœcious species, may be described as follows :—

Œdogonium dioicum, H. J. C., nov. sp. ? Pl. III. figs. 1, 2.

Filamentous, floating, of a greenish-yellow or yellow colour, according with the age and quantity of gonimic contents. Cells cylindrical, $2\frac{1}{2}$ to $3\frac{1}{2}$ times longer than broad; chlorophyll reticulated loosely, or in dense lines, more or less beaded with starch-cells; nucleus parietal. Male filaments a little less in width than the female ones; annular cells in groups of 10–20 between each 2–4 ordinary cells, with one or two larger than the rest; each annular cell bearing 2–3 spermatozoids. Female filaments a little wider than the male ones; spore-cells between every 4–6 ordinary cells, sometimes with only one intervening, marked in the undeveloped state by annular striæ at the upper end, part of which enters into the inflated portion; inflation ovato-conic, truncate, partially separating or dehiscing at the margin of the striæ for the protrusion of the internal layer or 'protoplasmic sac,' to form the micropyle, which is on the prominent portion. Resting-spore spherical, composed of granular protoplasm charged with starch-cells (?), chlorophyll, and a few oil-globules; surrounded first by a thin layer (the protoplasmic sac), and then a thick, coriaceous layer†. Width of female filament about $\frac{1}{800}$th inch;

* Ann. des Sc. nat. v. p. 253. pl. 15. Bot. 1856.

† I have already used the term 'protoplasmic sac' for the lining layer of the root-cell of *Chara* (Annals, xix. p. 15, 1857). All cells, when fully developed, have two proper coats, viz. the cell-wall and protoplasmic sac; hence it will be observed, in fig. 7, that the resting-spore is within four coats; and if this underwent deduplication, the two smaller cells would each have their proper coats, as the spermatozoids in fig. 8, *b*, and so on.

ditto of male filament, $\frac{1}{933}$rd; diameter of resting-spore, $\frac{1}{509}$th; length of spermatozoid, $\frac{1}{1966}$th.

Hab. Freshwater tanks in the island of Bombay; floating attached to *Ceratophyllum, Cladophora*, &c. Sporing in August and September.

Œ. diandronites *, H. J. C., nov. sp.? Pl. III. fig. 3.

All the characters of the foregoing, but with the sexes on the same filament, and the filaments smaller; also without dehiscence of the spore-cell. Male cells annular, in pairs, situated between every 1–2 ordinary cells, each bearing a single spermatozoid. Striæ on the spore-cells few, or altogether wanting; micropyle on the prominent portion of the spore-cell, marginate. Width of filament about $\frac{1}{933}$rd inch; diameter of resting-spore, $\frac{1}{622}$nd; length of spermatozoid about $\frac{1}{1866}$th.

Hab. The same as that of the foregoing species. Sporing in August and September.

Œ. triandronites, H. J. C., nov. sp.? Pl. III. fig. 4.

Filaments short, green, fixed; cells cylindrical, expanded at the upper part towards the free end of the filament. Sexes on the same filament. Male cells annular, in triplets, situated between every 2–4 ordinary cells, sometimes immediately under the spore-cells, each producing 2–3 spermatozoids. Spore-cell sphero-conic, truncate, with or without striæ above; micropyle simple, on the prominent portion. Spore spherical, presenting a peculiar beaded appearance at the circumference, apparently produced by corrugation of the outer or coriaceous coat (fig. 12). Width of filament $\frac{1}{1400}$th inch; diameter of resting-spore, $\frac{1}{622}$nd; length of spermatozoid unknown.

Hab. The same as that of the foregoing species, but parasitic on floating *Cladophora*. Sporing in August and September.

Observations.—It will have thus been seen that these three species of *Œdogonium* present unequivocal signs of distinction;

The protoplasmic sac is the 'primordial utricle' of Mohl, which is thus evidently misapplied. The terms 'nucleus' and 'nucleolus,' too, if changed to 'capsule' and 'nucleus' respectively, would be much better understood; for what is called the 'nucleus' is really the capsule of the 'nucleolus,' or better, of the nucleus. I have used the term 'resting-spore' here in contradistinction to the spore formed by the contents of the ordinary cell of *Œdogonium*, which, from rupture at the joints, frequently leave their cavity *en masse*, and assuming an ovoid form, swim about for some time, and then germinate.

* Ἀνδρὼν, a man's apartment.

the first being diœcious and polyandronitic (to coin more new terms for the occasion), the second monœcious and diandronitic, and the third monœcious and triandronitic; while these features being only present at the time of sporing, shows that *Œdogonium* can only be successfully studied for description during this period; and therefore holds out the hope that many other species of this interesting genus—now, as M. Thuret has stated (Ann. des Sc. nat. 1850), in almost inextricable confusion from their synonymy—may receive elucidation through similar means.

Fecundation.

Very soon after seeing Prof. Pringsheim's figure of the sporangium of *Œdogonium tumidulum**, I met with some spore-cells of *Œ. dioicum*, above described, in which the aperture pointed out by this talented observer was present; but it being late in the season (October), I could not obtain more for following up the process of impregnation, and so deferred it until this year. Meanwhile the first part of Pringsheim's description and illustrations of the act itself, in *Œ. ciliatum*† (the only part that I have been able to obtain), reached me, and I was thus well prepared to take advantage of the sporing of *Œdogonium* here, which, in consequence of the tanks having been filled by "the rains," for some time past, is now again taking place (Sept. 1857).

The first species obtained for observation was *Œ. dioicum*, in which the formation of the resting-spore and micropyle takes place in the following way: viz. when the spore-cell has become fully inflated, and the green gonimic contents uniformly and densely spread over its internal surface (fig. 1, *a*), a small, roundish, semi-transparent area makes its appearance in some part of the upper or prominent portion; the cell-wall now begins to open transversely opposite this point, in the direction of the margin of the striated portion, producing a short crevice, through the widest portion of which the internal layer or protoplasmic sac is projected in a thin globular form with a constricted base; this globular portion then disappears, apparently by dissolution, which, leaving the constricted base open, thus forms the micropyle (fig. 1, *b*). Meanwhile the gonimic contents separate themselves from the protoplasmic sac, and assuming a spherical figure, sink towards the lower part of the spore-cell, by which a vacuity is left in the upper part, for the reception of the spermatozoids previous to impregnation (fig. 5).

Synchronous with these changes in the spore-cell are similar

* Ann. des Sc. nat. iii. pl. 15. fig. 26. Bot. 1855.

† Ann. des Sc. nat. 1856, *loc. cit.*

ones which take place in the male filament, the annular cells of which appear to be opened by geniculation or dehiscence, which separating them from each other on one side, thus ruptures the partition portion of the cell-wall, &c., and permits the spermatozoids to escape into the water (fig. 8). When here, they at first remain stationary for a few seconds, to recover themselves from the shock of delivery, and then bound away in search of the resting-spores.

Having arrived at the micropyle, they now beat about it with the ciliated extremity for some time, occasionally causing the cell-wall to yield perceptibly before their pressure, until, by chance, they hit the right point, when they squeeze themselves through the aperture, and thus pass into the vacuity above the spore (fig. 5). Here, again, they repeat the beating movement, and evince various other motions indicative of their desire to enter or become incorporated with the resting-spore, which, if ineffectual, ends in their becoming stationarily fixed to its circumference or some part of the spore-cell wall (fig. 6).

In this way I have seen scores of instances in which there have been one to three spermatozoids in the spore-cell at the same time,—all in active movement, or one or two only moving or fixed, as the case might be; or one or more, more or less active; while in many instances they appeared to be half-incorporated with the spore (fig. 6), and in one case I thought that I could see the end of a spermatozoid in the transparent portion of the spore, after it had passed into it. But in this species I have never seen the act of incorporation itself take place, although I have kept resting-spores with one or more spermatozoids in active movement on them, for several hours together, under observation.

Hence I am inclined to infer that, for the completion of this process, it is necessary that the pellicles of both resting-spore and spermatozoid should be in a semi-fluid state; while that, when one or both become hardened, which appears to be a natural consequence, not under the control of either resting-spore or spermatozoid, the process must be checked. Again, as this is precisely the case with *Spirogyra,* which appears in all stages of arrest under sporing, so the separate globular form of the spermatozoid within the spore-cell, appearing in every degree from this up to its almost entire incorporation with the resting-spore in *Œdogonium,* seems to indicate that these are also arrests of incorporation from a similar cause, viz. the progressive hardening of the pellicle.

Let us now turn our attention to the sporing of the next species, viz. *Œ. diandronites,* which I obtained from the same tank as the foregoing one, separate and also in company with it.

The formation of the spore here does not differ from that of *Œ. dioicum*, saving that there is no dehiscence, apparently from the union of the protoplasmic sac with the cell-wall at the micropyle, which thus gives the latter a thickened marginate appearance; and the vacuity above the spore being much less in extent, which seems to prevent the spermatozoids from entering the spore-cell previous to impregnation. The dehiscence of the male cell for the escape of the spermatozoid is the same as that in *Œ. dioicum*.

After the spermatozoid has been liberated, it remains for a few moments, as in the former instance, to recover itself from the shock of delivery, and then bounds away in among the rest of the filaments; but, curious enough, when it can be followed, it is often found to return to the spore which has been developed nearest itself. Here, alone or with others, it may make successive efforts at incorporation, until at last it becomes fixed by its ciliated extremity to that part of the resting-spore which is close to the micropyle (fig. 9). Its shape now becomes irregular, indicative of the semi-fluid condition of its pellicle, and the exertions it is making to squeeze itself through the micropyle, and become incorporated with the resting-spore (fig. 10). This stage only occupies a few moments, when it disappears, seemingly by passing into the spore after the manner of a stone falling into water; but more probably the union is rather like that of a drop of water with water; for in the instance to which I am alluding, no trace of it, or the opening caused by its entry, could be subsequently detected in the resting-spore (fig. 11).

The rest of the spermatozoids (for there is frequently a plurality swarming round the micropyle) may continue their exertions for an hour afterwards without effect, as was the case in the instance under description (fig. 11), from which two inferences already deduced derive corroboration, viz. that the spermatozoids in this species do not enter the spore-cell previous to impregnation, as in *Œ. dioicum*; and that the pellicle of the resting-spore or of the remaining spermatozoids, or of both, had become too hardened to yield to incorporation; for the smallness of the spermatozoid compared with the resting-spore, and the fact of a plurality existing round the latter, indicate that more than one spermatozoid is required to complete the process.

Sometimes a filament of this species appears without any male cells, when the ordinary cells are longer and the resting-spore-cells without any micropyle, although their contents have assumed a spheroidal form.

Observations.—I have but little to add by way of remark on this mode of impregnation, further than that it seems to show that the sporing of *Spirogyra*, &c., is of the same kind, and

therefore equally impregnative. It is much more common to find one cell smaller than the other in the conjugations of *Spirogyra* than to find them of equal size. I have also alluded to this in the conjugations of the Diatomeæ which have come under my observation*, and am still inclined to think that this obtains frequently among many of these organisms, not altogether "as a mere accidental diversity and of no essential signification," as Prof. W. Smith thinks†, but indicative of an approach to that kind of impregnation in which the two bodies are unequal in size.

How the impregnated spore of *Œdogonium* germinates, has not yet, I think, been ascertained; that is to say, whether it developes a single filament, like the spore of *Spirogyra*, or a number of smaller spores, each of itself producing a new plant. *A priori*, I should be inclined to infer the latter; for the peculiar lenticular form of the capsules with which the resting-spore is filled, although they evince amylaceous contents under the action of iodine, is so like that of the capsules of *Euglena*, and so unlike that of the starch-grains of other Algæ, as to indicate a nature quite different from the latter. Moreover, some young plants of a large species of *Œdogonium* possessing just after germination a brown ring or collar round that point which divides the bud from the root, have frequently presented themselves to me in company with an organism which at first would be taken for a Thecamonadien, consisting of a lenticular, transparent capsule, with a peculiar, brown, corrugated rim, enclosing a green diplociliated cell with eye-spot and contracting vesicle; which peculiar, brown, corrugated rim, being precisely like that embracing the young plant of *Œdogonium* in company with it, has led me to the inference that this is in fact the spore of this *Œdogonium*. The species to which this young plant of *Œdogonium* belongs, I have not been able to ascertain; but certainly there are many plants of *Œdogonium* to be seen at this period without the ring, and therefore it may be that these have come from unimpregnated spores, such as those which I have before stated to be formed from the contents of an ordinary cell, escaping by a rupture at the joint (foot-note, p. 31). Does this ring or collar, then, afford a distinguishing mark of the young plant of *Œdogonium* produced by impregnation; and do the capsules contained within the resting-spore pass into zoospores like that just described before they germinate?

Abnormal Development.

There is a growth which frequently takes place from the

* Annals, xvii. p. 1, 1856.

† Synopsis of British Diatomaceæ, vol. ii. Introduction, p. xiii.

resting-spores both of *Œ. dioicum* and *Œ. diandronites*, so striking, that it would not be right to allow this opportunity to pass without figuring and describing it.

It consists of a conical, transparent, colourless cell, attached by a constricted portion to a more or less globular sac, which is imbedded in the substance of the spore. It may be single or in plurality; grouped, or growing out separately through different parts of the spore-cell; or protruding through the micropyle (fig. 13).

Its development takes place in the following way: viz. beginning within the resting-spore as a soft sac (apparently formed from a division of the protoplasm), it projects through its coats, and arriving at the spore-cell-wall, becomes constricted into a narrow point, which, passing through this wall, again dilates and assumes a conical form outside (fig. 13, *a*). The conical part then grows to a considerable size, and becomes filled with a fine, colourless, granular matter, which subsequently passes into a number of small, equal-sized, round nuclei, composed of a semi-opake, yellowish, refractive substance (*b*); these become more and more distinct, the granular matter entirely disappears, the pointed extremity of the cone is lifted up on one side in the form of a lid (fig. 14), and the nuclei are liberated, when they are seen to belong, respectively, to little globular, transparent cells, like monads, each of which is provided with a single, long cilium (fig. 15, *a*). These then bound off, and some may afterwards be seen attached to the outside of spore-cells, or moving round the micropyle by the polymorphic power which they also possess, or even within the spore-cell.

When the delivery of the litter is produced prematurely by pressure, they are preceded by a delicate sac, which bursting, is followed by a slow disintegration of the contents, arising from the difficulty with which the monads extricate the long cilium from the general mass.

This development, though never present until the spore has begun to assume a brown colour, indicative of the death of the chlorophyll, begins so early, that occasionally it is difficult to appreciate this change of colour without the presence of another spore in a healthy state, even when the group of cone-cells is almost fully formed. Hence it may be assumed that this growth takes place very rapidly indeed after the spore has begun to lose its natural vitality. A similar change in colour takes place in *Euglena*, *Spirogyra*, *Chara*, and all the Algæ, under similar circumstances, followed by similar developments, as I shall presently mention.

This conical cell, or abnormal development, appears to me to be closely allied to, if not identical with, Prof. A. Braun's *Chy-*

*tridium olla**, which also grows out of the sporangium of *Œdogonium*; and if so, the talented authors of the 'Micrographic Dictionary' make a mistake in referring the latter to the spore of *Œdogonium* described by Pringsheim†, which contains *chlorophyll* previous to the subsequent developments that take place in it; unless, indeed, they allude to these developments, which, according to my idea of the origin of *Chytridium*, or the conical cell I have described, are of the same nature. Neither should Prof. Braun's *Chytridium* be confounded with Prof. Pringsheim's 'androspore' of *Œdogonium ciliatum*‡. The latter, however, thinks that the former has described little plants of this kind among his new species of Unicellular Algæ§.

However, the growth I have described appears to me to be neither one nor the other, but an ultimate development of the protoplasm, which, though deprived of the part which bears the chlorophyll and the amount of formative power which is requisite to produce a new plant, nevertheless retains sufficient to form monads and polymorphic cells consecutively for a short time, until the whole is expended.

It is true that the monad of this development may return to the cell-wall of another spore-cell, and tubulate through it to the healthy spore, or effect this directly by entering through the micropyle; for I have frequently seen one present with the spermatozoids; since what the parent-cell can do one way the offspring may do the other; but a similar development may be seen among the contents even of the adjoining ordinary cells where there is no opening; and although they do not grow out into conical cells, the ultimate products, viz. monads, are the same. The same thing takes place in *Spirogyra*‖, where there is frequently a globular sac on the cell-wall that opens by a circular lid, if the latter may be inferred from the circular form of the aperture; while these sacs may be seen under polymorphism *inside* the *Spirogyra*-cell before they begin to tubulate through it. Besides, I shall soon have to show that a similar development takes place from the egg of the worm *Nais* when its development has been arrested. Lastly, take the protoplasm of the cell of *Nitella*, which is made up of mucus-cells in the natural, rotatory state; which cells, under certain circumstances, separately, enclose portions of the starch-bearing green layer, and ultimately bring forth a group of monads respectively¶. May

* "Rejuvenescence in Nature," Eng. Trans. by A. Henfrey, p. 185.

† Annals, vol. xi. p. 297, 1853.

‡ *Loc. cit.* § *Id.*

‖ Annals, vols. xvii. & xix. pp. 101 & 259, respectively.

¶ *Idem*, vol. xvii. *loc. cit.* See also similar transformations in *Euglena*, figured in the plates.

we not infer, that, under certain circumstances, this is a common termination of all protoplasms, both animal and vegetable?

It remains for me only to add here, that there is no difficulty whatever in making the foregoing observations, if the months in which the sporing of *Œdogonium* takes place, and the places where it has previously grown, be ascertained. One or two sporing filaments are not sufficient—the whole mass must be in this state; and then, if a portion be covered with a thin piece of glass, and supplied with water, the spermatozoids will after a short time leave their cells; and by choosing filaments with recently formed spores for observation, they will be seen to assemble round them. One filament will frequently afford a series of resting-spores in all stages of development, and may contain half a dozen with spermatozoids trying to enter them. The abnormal growth will be observed abundantly at the same time.

P.S.—Since the above was written, I have been able to determine the *Œdogonium* which is accompanied by the Thecamonadien, or rather, zoospore, whose brown rim (or a colour exactly like it) is found round the young plants of this species. It is monœcious, and having only one male or annular cell, affords another instance of the value of this specific character. Its description, so far as the scanty means left at my disposal, now the sporing has passed, admit of, may stand as follows:—

Œdogonium monandronites, H. J. C. (nov. sp.?)

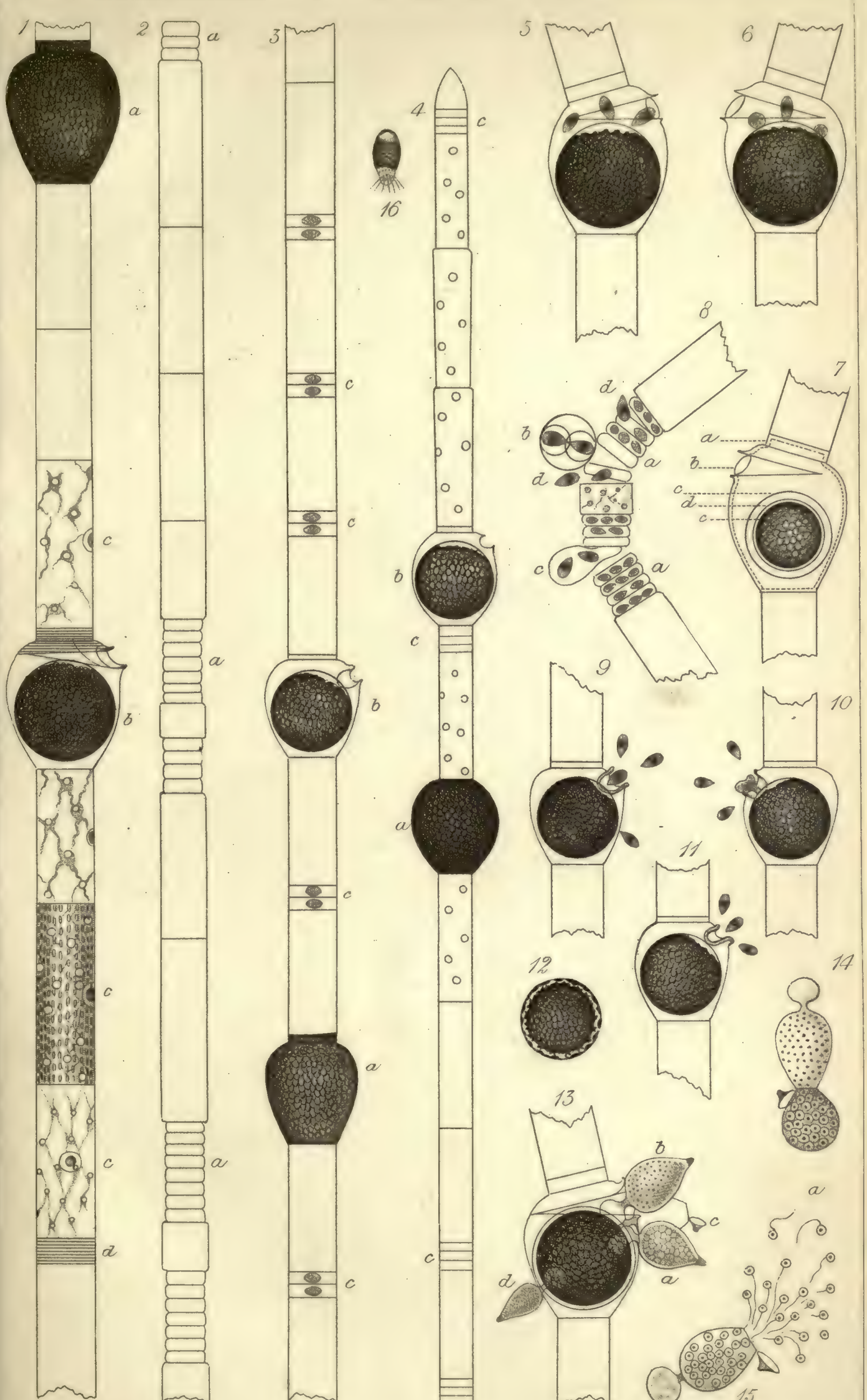
Filaments the same generally as those of *Œ. diandronites*, but a little less in size. Ordinary cells 3–5 times longer than broad. Spore-cell the same as in the species just mentioned, but a little more compressed laterally; indicated also, in the uninflated state, by the presence of annular striæ at the upper end; spore spherical at first, afterwards oblong. Male cell single, and situated here and there between every 1–5 ordinary cells. Width of filament about $\frac{1}{933}$rd of an inch; diameter of spore $\frac{1}{3600}$; spermatozoid unseen.

Hab. Floating with *Spirogyra* in the freshwater tanks of the Island of Bombay. Sporing in August and September.

EXPLANATION OF PLATE III.

N.B.—Figures 1–4 inclusive are drawn on a scale of 1-24th to 1-5600th of an inch, and the rest very near this; fig. 16 only is much more magnified, to show the cilia of the spermatozoid.

Fig. 1. *Œdogonium dioicum*, H. J. C. (nov. sp.?) Female filament: *a*, spore-cell previous to the formation of the micropyle and resting-spore; *b*, ditto after their formation; *c, c, c,* various forms



H. I. C. del[t].

J. Basire. sc.

assumed by the cell-contents (the rest of the cells in this as well as in the other filaments are not filled up, because the disposition of the contents in all is much alike); *d*, annular striæ indicative of a spore-cell before inflation.

Fig. 2. *Œdogonium dioicum.* Male filament: *a, a, a,* antheridia, or groups of annular cells producing spermatozoids. *Vide* fig. 8.

Fig. 3. *Œ. diandronites,* H. J. C. (nov. sp.?): *a,* spore-cell previous to the formation of the micropyle and resting-spore; *b,* ditto, after their formation; *c, c, c,* annular cells, two in each group, bearing each a single spermatozoid.

Fig. 4. *Œ. triandronites,* H. J. C. (nov. sp.?): *a,* spore-cell before the formation of the micropyle and resting-spore; *b,* ditto, after their formation; *c, c, c,* annular cells, three in each group, producing spermatozoids.

Fig. 5. Resting-spore of *Œ. dioicum,* with the spermatozoids trying to effect incorporation.

Fig. 6. Ditto, with three spermatozoids fixed, apparently in three different degrees of arrested incorporation.

Fig. 7. Diagram of resting-spore, &c., of *Œ. dioicum,* to show—*a,* cell-wall of filament and spore-cell; *b,* protoplasmic sac or internal layer; *c,* outer coriaceous or thick covering of resting-spore; *d,* inner or thin layer of ditto; *e,* contents, consisting of starch-cells (?), protoplasm, chlorophyll, and a few oil-globules.

Fig. 8. Male filament of ditto, in dehiscence, showing—*a, a,* annular cells bearing spermatozoids; *b,* protoplasmic sac or inner cell-layer of prematurely opened annular cell containing two spermatozoids, each of which is again enclosed in its proper cell; *c,* ditto, with the latter ruptured; *d, d,* spermatozoids escaping from their cells direct.

Fig. 9. Resting-spore of *Œ. diandronites,* with three spermatozoids round the micropyle, and one entering.

Fig. 10. Ditto, representing the spermatozoid in the act of incorporation.

Fig. 11. Ditto, after the incorporation, with the three remaining spermatozoids still swarming round the micropyle.

Fig. 12. Resting-spore of *Œ. triandronites,* to show the beaded appearance round its circumference.

Fig. 13. Ditto of *Œ. dioicum,* showing abnormal development of conical cells: *a,* conical cell, containing fine muco-granular matter; *b,* ditto with ditto having passed into monads; *c,* ditto, empty, with the lid attached; *d,* ditto, growing out from the opposite side.

Fig. 14. Conical cell separate, with the lid opened, and the contents issuing enclosed in a delicate sac.

Fig. 15. Ditto, with the sac burst, and the contents issuing in the form of monociliated monads.

Fig. 16. Spermatozoid more magnified, to show its cilia.

V.—*Gleanings in British Conchology.* By J. Gwyn Jeffreys, Esq., F.R.S.

[With a Plate.]

Being informed by Mr. Hanley, the surviving author of 'A History of British Mollusca and their Shells,' that it is not his intention to publish a supplement to that excellent work, I will

now present to your readers a notice of a few new species and some additional localities which have occurred to me during this year. Probably no department of the British fauna has been more assiduously and successfully explored than that of our native testaceous Mollusca; and, as some proof of this, I may observe, that since the publication of Messrs. Forbes and Hanley's work (now nearly five years ago), scarcely any addition has been made to the list of established species, notwithstanding the increase in the number of collectors, and the assistance given by the British Association to dredging operations on various parts of our coasts. The recent discovery of *Mangelia Holböllii* in the north of Ireland is almost a solitary exception.

For all the present additions to the British Testacea I am more or less indebted to my kind friend Mr. Barlee, who has again, with his usual liberality, placed at my disposal the results of his indefatigable and valuable labours. One of the new species (viz. *Diodonta Barleei*) was dredged by him off the west of Ireland. Two others (*Poromya subtrigona* and *Eulimella obeliscus*) I procured from shell-sand dredged by him off the Zetland coast. Another species (*Odostomia minima*) was originally discovered by him in the last-named locality; although it has been noticed (but not described or figured) by Forbes and Hanley in the Appendix to their work. Three others (*Arca nodulosa* of Müller, *Rissoa glabrata* of Philippi, and *Amphisphyra globosa* of Lovén) I now propose to add to the list; the first two having been found by me in Shetland and Skye shell-sand dredged by Mr. Barlee, and the last taken by him at Skye.

For some of the additional localities I have also to thank Edward Waller, Esq., of Lissenderry, near Aughnacloy, and Mr. Samuel Wright, jun., of Cork.

Reference will be given, in every instance, to the volume and page of the 'British Mollusca,' for the convenience of those who are especially interested in the subject, and may wish to judge for themselves as to the hitherto ascertained limits of distribution of any of the species here noticed.

I have again on this occasion adopted the Plinian use of the word 'uncia' to signify 'one-twelfth;' the integer being a foot, English measure.

I am in hopes of being followed and supported by other British conchologists in this endeavour to improve our knowledge of the native Testacea, so as gradually to form materials for a new edition of Forbes and Hanley's work. Every new locality (well authenticated, of course, in respect of accuracy and discrimination of species) will be most useful for this purpose. Some have been already recorded in previous pages of the 'Annals.'

Some of the species now noticed are "very rare," as far as specimens have been hitherto discovered; but it must be borne in mind that a few baskets of shell-stuff, or handfuls of sand, obtained by dredging, are but a very insignificant sample of those vast and various patches of sea-bottom which are dispersed over so many thousands of square miles within the line of soundings on our coasts. Further discoveries, therefore, both of species and specimens, may be confidently expected.

It is true that all the species which I here propose to describe or notice as new to this country, are small, and most of them even minute; but, far from adopting the maxim "de minimis non curat Lex," science regards with as much interest the tiniest productions of nature as the mammoth or the leviathan of the deep; and the revelations of the microscope are not less wonderful and important than those far-distant worlds which the telescope discloses to mortal eyes.

The recent separation by M. Milne-Edwards (and which has been adopted by M. de Quatrefages and other eminent zoologists) of the Tunicata from the true Mollusca has further narrowed the limits of this large and heterogeneous division of the Invertebrata, and might almost tempt Naturalists to revert to the use of the term (Vermes) TESTACEA, which the great systematist Linnæus proposed for the reception of what are now considered as Mollusca proper.

> "Multa renascentur, quæ jam cecidere, cadentque
> Quæ nunc sunt in honore vocabula, si volet usus,
> Quem penes arbitrium est, et jus et norma loquendi."

All the Mollusca, as at present defined, are more or less invested by, or secrete, shells; although the latter are occasionally in a rudimentary or imperfectly developed state, or are only found during the earliest period of their growth, as is the case with the Cephalopoda, Limacidæ, and Nudibranchiata. There are unquestionably some exceptions to this proposition, especially in some of the Cuttles and Slugs; but an exception proves the rule, and it cannot be said with less justice, that the true Mollusca are not testaceous, than that certain species of *Odostomia* which are destitute of teeth therefore do not belong to that genus. Similar instances in other branches of natural history will doubtless occur to many of your readers.

The discovery on the *east* coast of Zetland of *Rissoa glabrata*, which has been hitherto regarded as exclusively Mediterranean (to which must be added, among the Foraminifera, *Peneroplis planatus*), and also, in the same locality, of *Arca nodulosa*, an Arctic species, as well as, in the north of Ireland, of *Mangelia Holböllii*, an inhabitant of the North Seas, makes

one distrust more than ever the limits of definite provinces as laid down by theorists on geographical distribution. It is pretty evident that the once popular theory of the transmission of marine animals (not being pelagic) by means of the Gulf Stream, will not satisfactorily account for the above facts, because that current sets on the *west* of Zetland, and does not impinge on any part of our eastern coasts. As far, too, as the icy current is concerned, it does not flow at all between Iceland and the British Isles.

The great and startling changes in Geology, arising from the discoveries which have been recently published by Sir Charles Lyell in the Supplement to his 'Manual,' show the necessity of continual and extended observation in every branch of science where the materials are not patent or insufficient. While touching on this subject, I cannot admit the inference which has been drawn by Sir Charles Lyell from one of those discoveries, that, because at certain remote æras distinct natural-history provinces existed on various parts of the earth's surface (evidenced by the remains of animals which had lived during some part of those periods being found imbedded in strata which are supposed to be of contemporaneous formation), therefore there never was a uniform fauna. His own proposition, that present causes were formerly in operation, and which might have effected a disruption of any such uniformity, seems scarcely to warrant the above inference. Whether there ever was a uniform, or more properly speaking, a universal fauna, it is almost impossible, in the present state of geological knowledge, satisfactorily to determine.

Acephala Lamellibranchiata.

Pholas candida, *Forb. & Hanl. Brit. Moll.* i. 117. Barmouth.

Pholadidea papyracea, i. 123. Ballycotton, with Pholas candida, crispata, and dactylus (*Mr. S. Wright, jun.*).

Gastrochæna modiolina, i. 132. Barmouth; in limestone, probably imported from Anglesea.

Sphænia Binghami, i. 190. Cork Harbour (*Wright*).

Neæra cuspidata, i. 195. Arran Isle, county Galway (*Barlee*).

N. abbreviata, i. 201. Skye (*Barlee*).

Poromya subtrigona, n. s. Pl. II. fig. 1.

Testa oblique triangularis, ventricosa, inæquilatera, antice rotundata, postice latior et subtruncata, solidula, alba, nitida, strigibus transversis minutissimis confertis et striis remotis perpaucis versus marginem ventralem notata, intus radiatim striatula; margine antico subrecto; margine postico deciso; umbonibus prominulis, minime incurvis; lunula vix distincta; cardine, dentibus, fossa

cardinali et fovea ligamentali fere ut in *P. granulata*; long. $\frac{1}{25}$, lat. $\frac{1}{30}$ unciæ.

Only a single valve of this remarkable shell has occurred to me, in Shetland sand. It differs from the young of *Poromya granulata* in form, texture, and the absence of the scabrous markings which distinguish that species. I searched in vain the collections at the British Museum and of Mr. Cuming for its counterpart. I may be, perhaps, considered very rash in proposing to found a new species on a single valve; but I, of course, do so only *quantum valeat*, and would observe, that science has often benefited by the publication of any fact, however incomplete, the hiatus being afterwards filled up by further researches and discoveries.

Thracia villosiuscula, i. 224. Arran I., Galway (*Barlee*); Cork (*Wright*).

Diodonta Barleei, n. s. Pl. II. fig. 2.

Testa triangularis, subinæquilatera, compressa, antice productior, postice subtruncata, hyalina, nitida, fere glabra; marginibus lateralibus utrinque declivibus; margine ventrali rotundato; umbonibus prominentibus, rectis, nucleatis; lunula nulla; ligamento, cardine, et dentibus ut in *D. fragili*; long. $\frac{1}{20}$, lat. $\frac{1}{25}$ unc.

About a dozen specimens of different sizes were taken by Mr. Barlee in dredging off Arran Isle, on the west coast of Ireland. At first I suspected them to be the fry of *Diodonta fragilis*, which is not uncommon in the same locality; but, on comparing them with an umbonal segment of the same size, taken from a specimen of the latter species, I perceived that they would differ from the young of *D. fragilis* in being more compressed and obtusely triangular, and in the ventral or front margin being more rounded, besides being quite destitute of the transverse ribs and longitudinal grooves of that species. It should also be observed, that the fry of *Lucina Borealis* show most distinctly the transverse and irregular striæ or wrinkles, and are of the same relative shape as adult individuals. The present species bears some resemblance in form and size, but not in markings or dentition, to *Montacuta substriata*.

Scrobicularia piperata, i. 326. Barmouth.

Astarte triangularis, i. 467. Arran Isle, Galway (*Barlee*).

Cardium nodosum, ii. 22 (*C. papillosum* of Philippi being the older name). Barmouth.

C. Suecicum, ii. 33 (*C. minimum* of Philippi being prior in date, and more appropriate). Arran Isle, Galway (*Barlee*).

Lucina Borealis, ii. 46. Barmouth.

Montacuta ferruginosa, ii. 72. Barmouth.

M. bidentata, ii. 75. Barmouth; Shetland sand.

Kellia (Poronia) rubra, ii. 94. Barmouth.

Lepton nitidum, ii. 92, and var. convexum, ii. 102. Arran Isle, Galway (*Barlee*).

L. Clarkiæ, iv. 255. Arran Isle, Galway, and Fowey (*Barlee*);

Barmouth, where single valves are not uncommon; Skye sand. It has somewhat the appearance of *Montacuta bidentata*, and may have been overlooked for that species; but it essentially differs in form and dentition.

Pisidium nitidum, ii. 126. Barmouth.

Nucula nitida, ii. 218. Barmouth.

Leda pygmæa, ii. 230. Shetland sand.

Arca nodulosa, *Müll.* Prodr. Zool. Dan. p. 247; *Lovén*, Ind. Moll. Scand. Occid. p. 33.

I found a single valve of a young individual in Shetland sand; and it differs in no respect from Norwegian specimens of *Arca nodulosa* in the British Museum, or from a single valve which Mr. M'Andrew obligingly sent me for comparison, and which he obtained by dredging last year in the North Sea. Lovén refers this species, with doubt, to the *A. scabra* of Poli, and he supposes a variety of it to be identical with *A. aspera* of Philippi: but the number of hind teeth in the latter species is described by Philippi to be half as many again (viz. fifteen) as those in *A. nodulosa*. They may not, however, be specifically distinct. The present species may readily be distinguished from *A. lactea* (which is very variable in form and sculpture) by the position of the beaks, and having comparatively few and differently arranged teeth.

Lima subauriculata, ii. 263. Arran Isle, Galway (*Barlee*).

Pecten furtivus, *Lov.* (F. & H. ii. 284). Skye (*Barlee*), with *P. striatus*. This species differs, in form and sculpture, from all the varieties which I have seen of *P. striatus*, many hundred specimens of which, and about a score of *P. furtivus*, have passed through my hands. It is also a Mediterranean species; and M. Costa's collection, in the British Museum, from the coast of Naples, contains many specimens of this beautiful shell.

Anomia ephippium, ii. 325. I agree with Mr. Clark in considering *A. aculeata* to be merely a variety of this species; and I would also unite *A. striata* of Lovén with *A. patelliformis*.

Acephala Palliobranchiata, or Brachiopoda.

Terebratula caput-serpentis, ii. 353. Arran Isle, Galway (*Barlee*).

Gasteropoda Prosobranchiata.

Adeorbis subcarinata, ii. 541. Barmouth.

Lacuna crassior, iii. 67. Not uncommon in Swansea and the adjacent bays (omitted by Forbes and Hanley); Cleethorpe, Lincolnshire.

Rissoa rufilabrum, iii. 106. Barmouth; Shetland sand.

R. labiosa, iii. 109. Barmouth.

R. semistriata, iii. 117. Barmouth; Shetland sand.

R. rubra, iii. 120. Shetland and Skye sand.

R. glabrata, *Phil.* (and *R. punctulum* of same author). I found one adult and two or three immature specimens in the Shetland and

Skye sand, as well as characteristic examples of *Peneroplis planatus*, a Mediterranean Foraminifer, which Mr. Barlee had previously found in the same locality. Its nearest ally, as I remarked in my paper on Piedmontese Testacea (Annals, vol. xvii. p. 183), is *R. vitrea*. Under the microscope are discernible some faint but regular transverse striæ, which *R. vitrea* and probably every other apparently smooth species of *Rissoa* also exhibit with the same optical aid. The contour, substance, and colour, however, sufficiently distinguish this from any other species of *Rissoa*. Mr. Alder has pointed out to me that the upper whorls of this species, when examined under a microscope, appear punctured like the top of a thimble.

R. soluta, iii. 131. Shetland and Skye sand.

Jeffreysia diaphana, iii. 152. Barmouth; Skye sand.

J. globularis, iv. 268. Adult specimens from Skye sand have four whorls, and exhibit, under an ordinary magnifying power, coarse spiral striæ. The size is half as large again as that given by Forbes and Hanley. Operculum as in *J. opalina*. The fry are most abundant in Skye at the roots of sea-weed.

Skenea planorbis, iii. 156; var. hyalina. Skye sand.

S. nitidissima, iii. 158. Tenby and Gower Coast, South Wales (omitted in Brit. Moll.). Skye sand.

Id. var. hyalina. Skye sand; very rare.

S. rota, iii. 160. Tenby (omitted in Brit. Moll.); Skye sand.

Cæcum trachea, iii. 178. Barmouth.

C. glabrum, iii. 181. Barmouth; Skye sand.

Scalaria communis, iii. 206. Barmouth.

S. clathratula, iii. 209. Barmouth; Shetland sand.

Aclis ascaris, iii. 219. Arran Isle, Galway (*Barlee*); Barmouth.

A. supranitida, iii. 221. Barmouth.

Eulima bilineata, iii. 239. Skye sand.

Chemnitzia? (Aclis) unica, iii. 222. Barmouth.

Odostomia acuta, var. alba, iii. 269. Cork Harbour (*Wright*); Shetland sand.

O. plicata, iii. 271; var. spira breviore, anfractibusque versus basem angulatioribus; Skye sand. This form is almost intermediate between *O. plicata* and *unidentata*; and it must be admitted that many of the species are subject to considerable variation.

O. dubia, iii. 276. Barmouth; Shetland sand.

O. cylindrica, iii. 287. Groomsport, Belfast Bay (*Waller*); Skye sand. My specimen from the last-named locality has all the characters of this species, except in being a trifle broader, and possessing a small, but distinct, umbilical crevice, which is wanting in the typical form.

O. minima, n. s. Pl. II. fig. 3.

Testa oblongo-conica, hyalina, nitida, strigibus longitudinalibus remotis flexuosis leviter notata; anfractibus 5, convexiusculis, primo subheterostropho, ultimo reliquos superante; sutura profunda; apertura ovali, versus basin subeffusa, tertiam spiræ partem æquante; columella arcuata, dente exiguo, vix conspicuo, munita;

labro in adultis exemplis continuo, ad columellam subreflexo; umbilico parvo, angusto; operculo membranaceo, pauci-spirali; long. $\frac{1}{20}$, lat. $\frac{1}{50}$ unc.

This exquisite little shell, which is by far the smallest of the true *Odostomiæ*, was noticed by Forbes and Hanley at p. 282 of the Appendix to the 'British Mollusca,' as allied to the *Chemnitzia Gulsonæ* of Clark; but it is widely different from that species in its size, form, markings, and other respects. Its nearest ally, perhaps, is *Odostomia cylindrica*; but it may be distinguished from that and other species of *Odostomia* by its contour and the complete continuity of the lip in adult specimens. The first discoverer of this species was Mr. Barlee, who found it alive on the fronds and roots of *Laminaria digitata* in the littoral zone at Lerwick; and I have also found it, but sparingly, in shelly sand dredged by him in the same locality. I have had the operculum of *O. truncatula* figured in juxtaposition (Pl. II. fig. 4), as no representation of an Odostomian operculum is given in the 'British Mollusca.'

O. insculpta, iii. 289. Barmouth.
O. obliqua, iii. 291. Barmouth; Shetland and Skye sand.
O. dolioliformis, iii. 301. Barmouth.
O. decussata, iii. 303. Barmouth.
Eulimella affinis, iii. 313. Arran Isle, Galway (*Barlee*), with *E. acicula*. This appears to be its southernmost limit.
E. (Aclis) nitidissima, iii. 223. Arran Isle, Galway (*Barlee*); Shetland and Skye sand.

E. obeliscus, n. s. Pl. II. fig. 5.

Testa elongato-conica, solidula, nitida, alba, strigibus longitudinalibus vix conspicuis impressa; anfractibus 6, sensim increscentibus, complanatis; sutura parum profunda, obliqua; apertura trapeziformi, versus basin subeffusa, vix tertiam spiræ partem æquante; columella subrecta, incrassata, edentula; labro simplici, interrupto, superne inverso; umbilico nullo; long. $\frac{3}{40}$, lat. $\frac{1}{40}$ unc.

Of this distinct species I have only taken two or three specimens in Shetland and Skye sand. It has somewhat the aspect of a miniature *Eulimella Scillæ*, but is more nearly allied to *E. nitidissima*.

Cerithiopsis tuberculare, iii. 365. Barmouth.
Id. var. alba. Arran Isle, Galway (*Barlee*).
Nassa pygmæa, iii. 394. Barmouth.

Buccinum Holböllii.

Mangelia Holböllii, (*Beck*) *Möller*, Ind. Moll. Grœnl. p. 12.
Triton Holböllii, *Lov.* Ind. Moll. Scand. Occid. p. 12.
Columbella (Astyris) Holböllii, *Mörch*, Prod. Faun. Moll. Grönl. (1857) p. 14.

This species was announced at the last meeting of the British Association as having been taken in the north of Ireland. Mr. Waller (who obligingly presented me with a specimen) informs me that he

was one of the captors of this prize, in company with Dr. Dickie and Mr. Hyndman, and that all the specimens (about a dozen in number, of different sizes) were taken, in one haul of the dredge, from the Turbot-bank, a little north of the mouth of Belfast Bay, at a depth of about 20 fathoms. All the specimens appear to have been much water-worn, and deprived by friction of nearly every trace of those basal grooves and apical ribs which are observable in fresh specimens. The spire is rather shorter, and the whorls consequently are more swollen than in Norwegian specimens which are to be seen in the British Museum; Mr. M'Andrew having also kindly sent me some from the North Sea. The typical form appears to be allied to the *Buccinum minus* of Philippi.

Fusus antiquus, iii. 423. Barmouth. This appears to be the southernmost known limit for this species, as well as the northernmost for *Venus chione*.

Mangelia septangularis, iii. 458. Barmouth.

M. scabra (M. linearis, var.), iii. 470. Shetland sand. (See Ann. vol. xvii. p. 187.)

M. attenuata, iii. 488. Barmouth.

Gasteropoda Opisthobranchiata.

Cylichna strigella, iii. 518. Arran Isle, Galway (*Barlee*).

Amphisphyra globosa, *Lov*. Ind. Moll. Scánd. Occid. p. 11. A single specimen only was discovered by Mr. Barlee in dredging off Skye last year. It agrees fairly with Lovén's description; but he has not noticed the delicate, flexuous, longitudinal grooves which are discernible under a high magnifying power. The colour of the shell, when covered with the epidermis, is rufous brown. Owing to its expanded aperture, it has somewhat the appearance of a *Velutina*. As it has not yet been figured, I thought a drawing (Pl. II. fig. 6) by that excellent and accurate artist, Mr. J. de C. Sowerby, would be acceptable.

Philine quadrata, iii. 541. Arran Isle, Galway (*Barlee*).

P. punctata, iii. 547. Barmouth.

Gasteropoda Pulmonifera.

Zonites purus, iv. 37. Barmouth.

Z. radiatulus, iv. 38. Barmouth.

Z. excavatus, iv. 40. Gellygron, near Swansea; Llanberris, Tanybwlch, and Barmouth, North Wales.

Id. var. hyalina. Trosserch Wood, Carmarthenshire.

Helix Cantiana, iv. 50. Swansea (omitted in 'British Mollusca').

H. lamellata, iv. 73. Inverary (*Barlee*).

Pupa substriata, iv. 108. Barmouth.

P. antivertigo, iv. 109. Barmouth.

Cephalopoda Dibranchiata.

Spirula Peronii, iv. 242. Swansea Bay, with part of the animal

attached (omitted in 'British Mollusca'); but of course it can only be regarded, as well as the *Ianthinæ*, as occasional visitants of our coasts, having been probably brought hither by the Gulf Stream.

1 Montagu Square, London.
Dec. 1857.

EXPLANATION OF PLATE II.

Fig. 1. *Poromya subtrigona.*
Fig. 2. *Diodonta Barleei.*
Fig. 3. *Odostomia minima.*
Fig. 4. Operculum of *O. truncatula.*
Fig. 5. *Eulimella obeliscus.*
Fig. 6. *Amphisphyra globosa.*

VI.—*Descriptions of three new species of Diurnal Lepidoptera.* By FREDERIC MOORE.

Genus LIMENITIS, Fabr.

1. *Limenitis Mata*, Moore.

Distinguished from *Lim. Procris* by the black colour of the upper side, and deep red of the transverse band from apex of fore-wing to abdominal angle, and a short, transverse band near the base of the fore-wing; also in the white spots of the fore-wing being widely separated, and the broad white band on the hind-wing being short and extending to the middle of the abdominal margin.

Expanse, $2\frac{5}{8}$ inches.

Hab. Manilla. In Coll. Brit. Mus. and W. W. Saunders, Esq.

2. *Limenitis Calidosa*, Moore.

Differs on the upper side from *Lim. Zulema*, Doubleday, in having the hind-wings more rounded; the transverse maculated band being narrower, and its outer margin on hind-wing much scalloped; also the spots on the fore-wing are widely separated, especially those obliquely from the costal margin; and the two small subapical spots are absent.

Expanse 2 inches.

Hab. Ceylon. In Coll. Brit. Mus. and E. L. Layard, Esq.

Genus HESTINA, Westwood.

Diadema (*Hestina*), Westwood, in Doubleday and Hewitson's Diurnal Lep. p. 281 (1850).

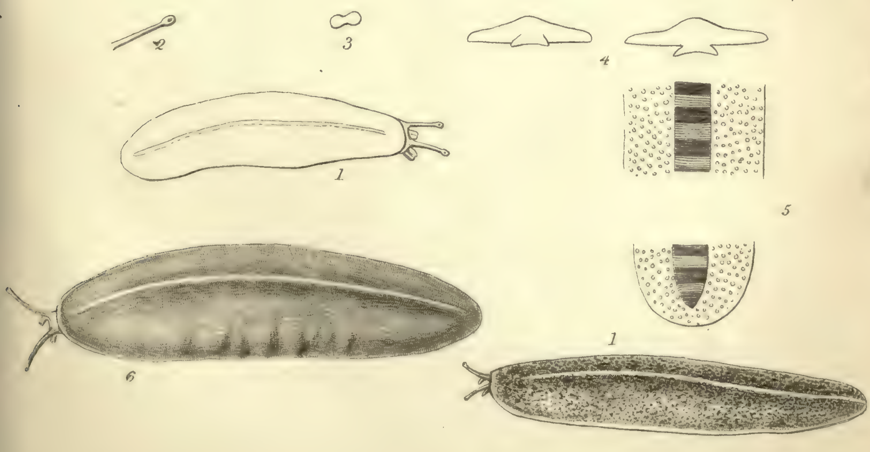
3. *Hestina Mena*, Moore.

Male. Upper-side pale greenish-white; fore-wing with all the

A

J. De C. Sowerby fecit.

B



J. De C. Sowerby sc.

veins broadly black; exterior margin black, with a marginal row of small spots, submarginal and third row of large and less distinct spots; hind-wing with all the veins black, also a marginal row of ill-defined, black, lunular spots. Under side paler greenish-white; all the veins of both wings less black than the upper side, with an indistinct marginal row of spots. Body longitudinally striped black and white.

Expanse 3½ inches.

Hab. N. India. In British Museum Collection.

Allied to *H. consimilis*, but may be distinguished by its larger size, and by the absence of the broad, transverse, spotted bands.

VII.—*On a new species of* Vaginula *from Ceylon.* By Robert Templeton, Esq.

[With a Plate.]

The genus *Vaginula* was formed by Férussac for the reception of small, flattish Limaces which he had received in spirits from Brazil: it formed the first genus of his second section Tetracera, which included the Slugs with four horns, as contradistinguished from the first section, made up of the single genus *Oncidium*, which had only the ocular pair. Shortly after the institution of the genus, Mr. Guilding added another species from the island of St. Vincent*, and subsequently other species were added by Lesson from Lima, by Van Hasselt from Batavia, and by Férussac himself from specimens forwarded to him from various parts of India. These species are described in the 'Histoire Naturelle des Mollusques,' p. 90 (1819). I believe, in respect to species, the genus remains much in the same state as when left by its distinguished author.

The species now added has most affinity to Hasselt's Batavian species, but is perfectly distinct from all: it is very common in moist places during the prevalence of the S.W. monsoon in the lower country about Colombo in Ceylon.

There is another species (Pl. II. B. fig. 6), somewhat larger and ferruginous in colour, with less obvious markings, in the district about Ratnapoora; but I have not had an opportunity of carefully examining it.

Vaginula, Férussac.

V. maculata, Temp. Plate II. B. fig. 1.

Body ovate-oblong, depressed, rounded behind; the dorsum

* Linn. Trans. vol. xiv. p. 323.

dark or brownish-grey, densely studded with minute papillæ; speckled with black, angular or irregular maculæ; a yellow mesial line down the back; margins edged with a yellowish or pale band; superior pair of horns hyaline, the buccal pair yellowish-grey.

The body never makes any approach to linear even when most extended; it is always rather broad, and fully rounded posteriorly, less so at the anterior extremity. There is no defined margin separating the central part from the edges; the latter are merely a little flatter: there is not the least trace of solid material in the covering or in the substance of the body. The superior pair of horns are cylindrical, somewhat longish, and terminate in a little rounded bulb, on the upper surface of which the minute black eye is imbedded; the buccal pair is bilobed, but not deeply sulcated, appearing exactly as if two short cylinders were under a skin. The foot terminates a little before the end of the mantle; it occupies in breadth about one-fifth or rather more of the under surface, and is separated by a deep groove from the mantle, so that it appears as if winged: it has about 200 transverse rugæ in the inch, which, in the advancing movement of the animal, present precisely the same appearance as the legs of *Julus*, a wave running from behind forward, about six rugæ forming each wave, with an interval of fourteen to eighteen between them. The under surface of the body of the animal on each side of the foot is covered with minute papillæ or tubercles, about 180 in an inch.

The habits of the animal, as far as I had an opportunity of examining them, appear to differ in no respect from those of *Limax*.

EXPLANATION OF PLATE II. B.

Fig. 1. *Vaginula maculata.*
Fig. 2. Ocular tentacle.
Fig. 3. Section of buccal tentacle.
Fig. 4. Transverse sections of body.
Fig. 5. Lower surface of body and foot.
Fig. 6. *Vaginula* —— ?

VIII.—*On the Occurrence of Marine Animal Forms in Fresh Water.* By Dr. E. von Martens*.

The genera *Sphæroma* and *Palæmon, Gobius* and *Blennius* occur plentifully in the North Sea, but are entirely unknown in the

[* Translated by W. S. Dallas, F.L.S., from Wiegmann's Archiv, 1857, p. 188. This paper forms the third section of a long memoir "On some

fresh waters of Northern and Central Europe. That, on the contrary, several species of *Blennius* occur in the fresh waters of Southern Europe, has been already observed; the family of the *Gobioidei* includes numerous East Indian freshwater fishes, several belonging to the genus *Gobius* itself. As regards *Palæmon,* a freshwater crustacean ('Camaron de agua dolce,' *Palæmon Jamaicensis,* A.) of Jamaica and Cuba has been known since the time of Sloane and Parra; and, according to an oral statement of Dr. Engelmann, a species of this genus (still undescribed?) lives near St. Louis in N. America. To the same family belong the Sicilian *Symethus fluviatilis* of Rafinesque, which, although so imperfectly described and again denied, rests upon some observation, and also the *Hippolyte Desmarestii* of Millet, discovered some time since in the Mayenne, the Sarthe and other rivers of the north-west of France *; Dana's Chilian freshwater crustacean, *Cryphiops spinulosomanus*; and lastly, the pale, eye-less Cavern Shrimp (*Troglocaris*) of the Adelsberg caves. Associated with the latter is the recently-discovered *Monolistra*; this has hitherto been the sole known freshwater representative of the *Isopodes nageurs* of Milne-Edwards (*Cymothoidea,* Dana), to which *Sphæroma* belongs.

Several families also, which, even in the region of the Mediterranean as in the North Sea, are purely marine,—of which the most remarkable examples are the *Scomberoidea,* and Sharks and Rays,—are represented in tropical regions by freshwater forms (*Monocirrhus polyacanthus,* Heckel, in the Rio Negro; *Carcharias gangeticus,* Müll. & Henle, sixty leagues above the sea; *Pristis Perroteti,* Müll. & Henle, in the Senegal; *Raia fluviatilis,* Ham.-Buch., near Kampur, 1000 English miles above the influence of the tide; and the *Trygon* discovered by Schomburgk in the River Magdalena). The entire section of the Brachyurous

Fishes and Crustacea of the Italian Fresh Waters," the occurrence of a Blenny in which was pointed out by Pollini as long ago as 1816. The most important species observed by the author were—

Atherina lacustris, Bonap.
Blennius vulgaris, Pollini.
Gobius fluviatilis, Bonelli.
Leuciscus alburnellus, Filippi.
Leuciscus Savignyi, Val.
Alosa finta, Troschel.
Palæmon lacustris, n. sp., in the Lake of Albano.
Sphæroma fossarum, n. sp., in the Pontine Marshes.

These species are all described in the second part of his memoir, and both this and the first part contain remarks upon other animals inhabiting the fresh waters of the South of Europe, which belong to what are generally regarded as marine groups.—TRANSL.]

* Ann. Sci. Nat. xxv. pl. 10. fig. B. 1832.

Crabs, existing in the sea as far as Greenland and Spitzbergen, is only represented in the fresh water in the subtropical climates by one *Thelphusa*, and rises in the West Indies by the *Gecarcinus* to a permanent dwelling on land. Amongst the bivalve Mollusca, *Arca scaphula*, Benson, lives in the Jumna near Humerpoor, at a distance of 1000 English miles from the sea, and *Pholas rivicola*, Sow., in the fresh water of the river Pantai, twelve English miles above its mouth, in floating wood. Thus our usual notion of the distribution of marine and freshwater animals in different families, derived from the circumstances of our native country, is more and more modified with the advance of knowledge, and it becomes a question which of the numerous families of aquatic animals are exclusively proper to one of the two media, and how far the dwelling-place is in accordance with the systematic position, that is to say, with the modifications of organization,—a question which is of peculiar geological interest. To arrive at a result which shall not be entirely negative, it will be advisable to pay no regard at all to the multifarious mixtures and points of transition between the two elements, such as are presented on a small scale by the mouths of rivers and saline lakes, and on a large scale by the Baltic and Caspian Seas, and to confine ourselves solely to the contrast of rivers and inland lakes with the open sea. We must also disregard the distinction of the families whose species all live in the sea, and of which some only ascend temporarily into the fresh water (such as *Alosa*), from those which possess a few constant representatives in the latter medium (e. g. *Lota*), as with regard to many, and some of these the most interesting of the exotic river-fish, we do not know whether they are migratory or stationary. With these limitations, and the still more important ones of our present knowledge, the following Table furnishes a summary of the freshwater animals amongst the Fishes, Crustacea and Mollusca, according to families and climatic zones, especially for the Old World, in which, however, those occurring only in the other hemisphere are inserted, with the corresponding indication, N. Am., S. Am., or Austr. (North America, South America, Australia). With regard to its freshwater animals, Iceland is related to the countries of the high northern latitudes; Central Europe is considered to extend southwards to the principal range of the Alps; Egypt and Syria (on account of *Mastacemblus*) are referred to the torrid zone.

o. Indicates that the family does not occur in this zone.
m. Indicates that the family only occurs in the sea in this zone.
—. Indicates that the family occurs both in the sea and in fresh water in this zone.

†. Indicates that the family only occurs in fresh water in this zone.

The parentheses indicate rare, or rather occasional occurrence. The families printed in italics are exclusively inhabitants of fresh water.

		I. Greenland and Iceland.	II. Scandinavia.	III. Central Europe.	IV. Southern Europe.	V. Torrid zone.
Pisces.						
DIPNOI	*Sirenoidei*	o	o	o	o	†
ACANTHOPTERI	Percoidei	o	—	—	—	—
	Cataphracti	—	—	—	—	m[1]
	Sciænoidei	o	(m)	m (N. Am. Austr.)	m	—
	Labyrinthici	o	o	o	o	†
	Mugiloidei	o	m	m	m[2]	—
	Atherinoidei	o	o	m	—	m
	Notacanthini[3]	m	o	o	o	— ?
	Scomberoidei	m	m	m	m	—[4]
	Blennioidei	m	m	m	—	m ?
	Gobioidei	m	m	m	—	—
ANACANTHINI	Gadini	m	—	—	—	o ?
	Pleuronectidi[5]	m	—	—	—	m ?
PHARYNGOGNATHI	*Chromides*	o	o	o	o	†
	Scomberesoces	o	m	m	m	—[6]
PHYSOSTOMI	Siluroides	o	o	† (N. Am.)	o (N. Am.)	—[6b]
	Loricariæ	o	o	o	o	†
	Cyprinoidei	o	†	†	†	†
	Characini	o	o	o	o	†
	Cyprinodontes	o	o	o	o	†
	Mormyri	o	o	o	o	†
	Esoces	o	†	†	†	o
	Galaxiæ	o	S. Am. †	Austr. †	o	o
	Salmones	—	—	—	†	o
	Clupeoidei	m	m ?	—	—	—
	Hyodontes, Val.	o	o	N. Am. †	N. Am. †	†
	Elopes, *Val.*	o	o	o	o	—
	Heteropygii	o	o	N. Am. †	o	o
	Muræenoidei	—	—	—	—	—
	Gymnotini	o	o	o	o	†
	Symbranchii	o	o	o	o	—
PLECTOGNATHI	Gymnodontes	o	(m)	(m)	m	—[7]
LOPHOBRANCHII	Lophobranchii	o	m	m	m	—[8]
GANOIDEI	*Polypterini*	o	o	o	o	†
	Lepidosteini	o	o	o	N. Am. †	Am. †
	Amiæ	o	o	o	N. Am. †	o
	Acipenserini	m	—	—	—	o ?
	Spatulariæ	o	o	o	N. Am. †	o
PLAGIOSTOMI	Squali	m	m	m	m	—[4]
	Rajæ	m	m	m	m	—[4]
CYCLOSTOMI	Petromyzones	m	—	—	—	?

		I. Greenland and Iceland.	II. Scandinavia.	III. Central Europe.	IV. Southern Europe.	V. Torrid zone.
Crustacea[9].						
Podophthalma	Brachyura in general	*m*	*m*	*m*	—	—
	Thelphusinea	*o*	*o*	*o*	†	†
	Astacidea	*o*[9]	—	—	—	—
	Caridea	*m*	*m*	—	—	—
Tetradecapoda	Idoteidea	*m*	*m*	*m*	(S. Am.[10])	*m*
	Oniscidea	—?[11]	—	—	—	*m*?
	Cymothoidea	*m*	*m*	*m*	—	*m*?
	Gammaridea	—	—	—	—	—?
Gnathostoma	Cyclopoidea	*m*?	—	—	—	—
	Daphnoidea	†	†	†	†	†
	Cyproidea		—	—	—	—
	Artemioidea	*o*		†	†	†[12]
	Apodoidea	—	—	—	†	†
	Limnadioidea	*o*		†		†
Cormostoma	Caligoidea	*m*	*m*	—	?	
	Lernæoidea	*m*	—	—	—?	
Mollusca.						
Gasteropoda ctenobranchia.	*Melaniacea*[13]	*o*	*o*	†	†	†
	Paludinacea[13]	†?	†	†	†	†
	Neritacea	*o*	†	†	—	—
Gasteropoda pulmonata.	*Limnæacea*	†	†	†	†	†
	Ampullariacea	*o*	*o*	*o*	N. Am.†	†
Conchifera	Mytilacea	*m*	*m*	—	—	—
	Arcacea	*m*	*m*	*m*	*m*	—[4]
	Najadea	*o*	†	†	†	†
	Cycladea	†	†	†	†	†
	Tellinea	*m*	*m*	*m*	*m*	—[14]
	Solenacea	*o*	*m*	*m*	*m*	—[15]
	Pholadea	*o*	*m*	*m*	*m*	—[4]

Remarks.

1. Tropical species of *Gasterosteus* or *Cottus* are unknown to me.

2. Schmarda (Geogr. Verbreitung der Thiere, p. 59) speaks of Sea Mullets in the pond near Arcach; this is unknown to me. In a lake near Arquà (not far from Padua), sea fishes are to be found according to a popular tradition. Species of *Mugil* are often kept in Italy in brackish water ponds, and in France they ascend the rivers in abundance (see Valenciennes), but I do not know how far they go into pure fresh water. In tropical countries, *Mugil liga*, *Nestis*, and *Dajaus* occur in fresh water.

3. *Campylodon* in the Greenland Sea; *Mastacemblus* in Indian rivers and even near Aleppo (Russell).

4. See p. 51.

5. *Platessa flesus*, according to Nilsson, ascends in Sweden as far as the peat moors of Jaeravallèn, and probably in the Rhine as far as Bonn, as Dr. Günther has had the kindness to inform me from the statements of fishermen. The nearly allied Passara (*Pl. passer*, Bp.) ascends the Po even into the small rivers Tar-

taro and Molinella, as was indicated by Pollini (Viaggio al Lago di Garda, p. 22). With regard to *Pl. limanda* and *Pl. Solea,* consult Schmarda (*op. cit.* p. 148). I do not know whether ascending species also occur in the torrid zone; but according to Hamilton-Buchanan, some species are abundant in the brackish water of the Ganges, up which they pass as far as the tide reaches.

6. *Belone cancila,* Ham.-Buch., and *caudimacula,* Val., in the East Indies. According to Professor Peters, *Hemiramphus far,* Rüpp., ascends the rivers in Mozambique.

6 *b*. *Galeichthys marinus,* Mitchill (*Parræ,* Val.), of Cuba and New York, *G. feliceps* of the Cape, and *Plotosus lineatus,* Val., found from the Red Sea to the Friendly Islands, are sea fishes.

7. *Tetrodon fahaca,* Forsk., in the Nile; other species in the Ganges.

8. *Syngnathus deocata,* Ham.-Buch., in the Kawarlayi river in Northern Bengal; *S. Zambesensis* and *Argulus,* Peters, in Mozambique.

9. Of the distribution of the marine Crustacea Dana has given a most copious summary at the conclusion of his great work, of which I have availed myself with pleasure; his frigid zone corresponds with my No. I., subfrigid with II., cold temperate and subtemperate, III., temperate (the Mediterranean Sea) and warm temperate, IV., subtorrid and torrid, V.

10. *Chætilia ovata,* Dana, from Chili, is a freshwater species.

11. *Jaera,* Leach, a marine genus of the subdivision *Asellidæ,* the species of which occur from Greenland to the warm temperate zone. The occurrence of the *Asellus* in Greenland is doubtful; Fabricius himself did not see it. Nothing belonging to this subdivision is known from the tropics.

12. The Brine Shrimps (*Artemia*) are certainly not freshwater animals, nor do they live in the sea. The other members of this division are freshwater animals (for example *Branchipus*).

13. In this case I follow Woodward's division, according to which the spiral operculum constitutes the distinction between the two families—(by this, *Hydrobia,* Hartm. and *Lithoglyphus,* Mhlfld. must be referred to the *Melaniacea*)—but I think that their separation from the *Littorinida* is scarcely admissible, and that it was only tried on account of the difference of habitation. Such a wide separation of the smooth *Rissoæ* (*Paludinella,* Lovén, Beck) from *Hydrobia,* Hartm. (*Amnicola,* Haldeman, *Paludinella,* J. C. Schmidt) especially cannot be allowed.

14. Here, according to Woodward, the African *Galathea.* The *Ætheriæ* are referred by him to the *Najadea.*

15. *Novaculina gangetica,* Bens., perhaps only in brackish water, like *Potamomya* (Corbulacea) and *Gnathodon* (Mactracea).

The following considerations arise out of this Table:—

A. If we add for each zone the marine families occurring

therein (taking for the Crustacea only Dana's higher divisions in *-inea* or *-oidea*, and not the families in *-idæ*, in order to avoid too minute a division), the number of families appears to be:—

	Exclusively in Sea.	Exclusively in Fresh water.	Common to both.	Total.
Fishes	16	16	23	55
Crustacea . . .	29	3	10	44
Mollusca* . . .	40	6	6	52

Thus the number of the freshwater and marine forms is equal only for the Fishes; and even here, if we divide the Plagiostomi, which were referred to for the sake of the general view only as *Rajæ* and *Squali*, into J. Müller's 16 or 21 families, of which only 4 occur also in fresh water, the marine species acquire a preponderance.

According to the zones they are distributed as follows:—

	a. Common forms.	*b*. Exclusively Marine.	*b*. Exclusively Freshwater.	Proportion of *a* to *b*.
I. Cold Zone.				
Fishes	3	15	0	1 : 5
Crustacea............	3	17	1	1 : 6
Mollusca	0	27	3	1 : 8
II. Cold Temperate Zone.				
Fishes	8	19	2	1 : $2\frac{5}{8}$
Crustacea............	7	24	1	1 : $3\frac{4}{7}$
Mollusca	0	34	5	1 : ∞
III. Middl(Temperate Zone.				
Fishes	11	18	4	1 : 2
Crustacea............	8	28	3	1 : $3\frac{7}{8}$
Mollusca	1	39	6	1 : 45
IV. Warm Temperate Zone.				
Fishes	11	19	7	1 : $2\frac{4}{11}$
Crustacea............	9	25	4	1 : $3\frac{2}{9}$
Mollusca	2	43	6	1 : $24\frac{1}{2}$
V. Torrid Zone.				
Fishes	16	21	11	1 : 2
Crustacea............	5 ?	26	5	1 : $6\frac{1}{5}$?
Mollusca	6	40	6	1 : $7\frac{2}{3}$

We see, consequently, that from the cold to the torrid zone there is an increase of the common families; the exception of the Crustacea in the torrid zone may only be apparent, and due to our imperfect knowledge of the tropical freshwater animals. This increase is not only an absolute one, such as is shown also by the exclusively marine and freshwater families, and such as was to have been expected, but a relative one, at the expense of

[* The term *Mollusca* here and in the following Tables is used for brevity to signify the *Gasteropoda* and *Conchifera* alone, these being the only classes of Mollusca represented in both salt and fresh water.]

the exclusive families. The common families form a greater portion of the total number of families represented in that zone.

B. But even the number of the exclusively freshwater families increases in proportion to those which occur also in the sea, or only in salt water, from the cold to the torrid zone; this is very decidedly the case with the Fishes (I. $1:\infty$; II. $1:13\frac{1}{2}$; III. $1:9\frac{3}{4}$; IV. $1:4\frac{2}{7}$; V. $1:3\frac{4}{11}$), but also distinctly with the Mollusca (I. $1:9$; II. $1:6\frac{4}{5}$; III. $1:6\frac{2}{3}$; IV. $1:7\frac{1}{2}$) and with the Crustacea (I. $1:20$; III. $1:12$; IV. $1:8\frac{1}{2}$; V. $1:6\frac{1}{5}$).

C. In the same way also the number of families occurring in the fresh water generally, increases in proportion to that of those occurring generally in the sea; thus in

	I.	II.	III.	IV.	V.
Fishes.........	$1:6$	$1:3\frac{9}{10}$	$1:2$	$1:1\frac{2}{3}$	$1:1\frac{1}{3}$
Crustacea ...	$1:5$	$1:3\frac{7}{8}$	$1:3\frac{3}{11}$	$1:2\frac{11}{13}$?	$1:3\frac{1}{10}$
Mollusca......	$1:9$	$1:6\frac{1}{5}$	$1:5\frac{5}{7}$	$1:5\frac{5}{8}$	$1:3\frac{5}{6}$

Here again also the tropical freshwater Crustacea constitute the sole exception, probably in consequence of deficient information. This increase, like that under B, is the confirmation of a general law, which has already been expressed as follows:— Towards the poles, organic life retreats from the severe climate of the land to the more temperate climate of the ocean: where, as in Greenland*, the entire interior of the country is a permanent mass of ice, and the alternation of thaw and frost only occurs on the coasts and bays, the freshwater fauna will not be very rich.

D. Of the freshwater families those which are exclusively peculiar to this medium, are in proportion to those common to it and the sea in

	I.	II.	III.	IV.	V.
Fishes.........	$1:\infty$	$1:4$	$1:2\frac{3}{4}$	$1:1\frac{4}{7}$	$1:1\frac{1}{3}$
Crustacea ...	$1:3$	$(1:7)$	$1:2\frac{2}{3}$	$1:2\frac{1}{4}$	$1:1$?
Mollusca ...	$1:0$	$1:0$	$1:\frac{1}{6}$	$1:\frac{1}{3}$	$1:1$

Here, therefore, there is a remarkable contrast between Fishes and Mollusca; in the former the common families everywhere predominate over the exclusive ones (although not in number of species), but this preponderance diminishes constantly and considerably from the cold zone, where it finds no balance, to the equator; in the Mollusca the common families never predominate over the exclusive ones, but their proportion to the latter increases in the same direction from 0 to equality; in both classes, therefore, a progressive equalization takes place towards the equator, but towards the poles a divergence in

* See Rink, Grönland geographisk og statistisk beskrevet. Kjöbnhavn, 1857.

opposite directions, as here, amongst the Fishes the common *Salmones*, and amongst the Mollusca the exclusively freshwater *Limnææ* and *Pisidia* prevail, the former protected from the frost by their migrations, and the latter by their hybernation.

E. There are families which are common to both media in one zone and peculiar to one of them in another; of the four cases possible here, we have in the

	Fishes.	Crustacea.	Mollusca.
a. Exclusively marine in a colder zone than that in which they are common	17	6	5
b. Exclusively freshwater in the cold zone			
c. Exclusively marine in the warmer zone	5	2	
d. Exclusively in fresh water in the warmer zone		1	

Of these the deficiency of the *Blennioidei, Pleuronectidei* and *Apodoidei*, and perhaps also that of the *Atherinæ, Idoteidea* and *Cymothoidea* in the fresh waters of the tropical zones, as well as that of the *Sciænoidea* in the subtropical, and of the *Lernæoidea* and *Cyclopoidea* in the cold zone, may be due solely to the deficiency of our information, by which in *a* 2, and in *c* and *d* all the examples would be cancelled. For *b*, the Silure in the Old World furnishes a striking instance; but in America there is in the same zone a marine Silure (*Galeichthys marinus*, Mitch.). The *Siluroidei*, and perhaps also *Petromyzon*, present the only examples of families living especially in fresh water with individual representatives in the sea; the other common families generally exhibit the opposite relation.

Of the families included under *a*, the following first make their appearance in the particular zones in

	II.	III.	IV.	V.
Of the Fishes	4	2	3	8
Of the Crustacea	3	2	1	
Of the Mollusca		1	2	3

This phænomenon is therefore most remarkable and regular amongst the Fishes (*Gadini, Clupeoidei, Blennioidei, Lophobranchii*); amongst Crustacea, according to our present knowledge, it makes its appearance distinctly even in the temperate zone (*Caridea, Idoteidea, Cymothoidea*), but amongst the Mollusca only in the tropical zone: that it exhibits the greatest number of examples in Zones II. and V., is probably because II. to IV. are merely subdivisions of the one temperate zone, so that only II. and V. mark the occurrence of a new principal zone.

From this we may formulate the following propositions for the above-mentioned four classes:—

1. The majority of the family-forms, both generally and in each zone, belong exclusively to one of the two media (A).

2. The inhabitants of the fresh water generally and in each zone are more uniform (and less numerous) than the inhabitants of the sea (C).

3. The inhabitants of fresh water increase from the pole towards the equator, not only absolutely, but also relatively in proportion to the inhabitants of the sea, in multiplicity of forms (and in number) (C).

4. This increase depends not only upon the development of new peculiar forms, but also upon participation in the marine forms (D).

5. The similarity of the individual freshwater animals to individual marine animals decreases from the pole towards the equator (B).

6. The similarity of the total freshwater fauna to the total marine fauna increases from the pole towards the equator (A).

The apparent contradiction of the two preceding propositions is explained by the fact that in the fifth the exclusively marine families are not taken into consideration at all, but that in the sixth they, as well as the exclusively freshwater forms, form the negative factor.

7. Numerous family-forms are exclusively marine in colder regions; in warmer regions (still principally marine, but) also represented (by individual species) in the fresh water (E).

Here especially belong those animals which led to the preparation of the present memoir.

The above propositions of course only apply so far as the families adopted as the foundation for the calculation within each class may be regarded as equivalent with respect to the similarity of their structure. Advances in systematic zoology, therefore, as well as in the knowledge of faunas, which is still so very deficient, especially for the tropical regions, may modify them. A comparison of the three classes amongst themselves, according to which the similarity between the Molluscous fauna of the sea and of the fresh water in each zone is less than that of the Crustacea, and this less than that of the Fishes, would also at the same time presuppose the equivalence of the divisions adopted in all the four classes, which however will remain a matter of individual opinion. Thus, had I adopted as a foundation for the Crustacea, the numerous subdivisions which Dana calls families, the numbers for the freshwater species would have proved but little greater, whilst those for the marine forms would have been considerably higher, because amongst these subdivisions also the marine animals again predominate; within each separate zone, therefore, the relative number of the inhabitants

of fresh water to those of the sea would have become smaller, but the increase or decrease according to the zones would not have changed, or only unessentially. If we advance to the higher steps of classification, the numerical agreement between the two media constantly becomes greater, but the differences which still remain are of a more essential nature. This is the case even in the consideration of the orders:—Of the fourteen which J. Müller has adopted for the class of Fishes, only five, and these very poor in species (with 1—3 genera, and not many more species), are limited to one of the two media,—the *Sirenoidei* and *Ganoidei holostei* to fresh water, and the *Holocephali* (*Chimæra*), *Hyperotreti* (*Myxine*), and *Leptocardii* (*Amphioxus*) to the sea*.

Amongst Dana's larger sections of the Crustacea, one-half (seven) in number are certainly peculiar to the sea:—*Anomura, Stomapoda, Schizopoda, Aploopoda, Anisopoda, Merostoma, Cirripedia,* but these are all poor in species; not one is peculiar to the fresh water; and of the three principal sections, Podophthalma, Edriophthalma and Cirripedia, two are common. In the Annelida, on the contrary, we find not only that the majority of the orders (three to two, according to Grube) are exclusively marine, but also that these are by far the most developed and most numerous. In the Gasteropoda also, the exclusively marine orders predominate, and hold the balance against the common and freshwater orders together; thus, according to Troschel's classification, there are five orders, Heteropoda, Cyclobranchiata, Notobranchiata, Monopleurobranchiata, and Hypobranchiata, against the two common orders, Ctenobranchiata and Rhipidoglossata, together with the entirely non-marine Pulmonata and Pulmonata operculata (Troschel, however, excludes the Heteropoda); in the more recent English systems, especially in Woodward's, we have the two marine orders, Nucleobranchiata and Opisthobranchiata, against the common Prosobranchiata and the non-marine Pulmonifera, but still of the two most numerous orders, the one always includes the common, and the other the non-marine forms (disregarding the *Auriculæ, Onchidiæ* and *Amphibola,* which dwell upon the borders). An essential difference for the orders, according to the zones only, occurs with the Fishes, the two exclusively belonging to the freshwater (*Sirenoidei, Ganoidei holostei*), being those which are wanting in the colder regions; amongst the Gasteropoda the colder zones are destitute both of the marine Heteropoda (Nucleobranchiata) and of the non-marine Operculated Pulmonata, and amongst the Crustacea

* The Berlin Museum has received an *Amphioxus* from Ceylon, from M. Nietner. It is unfortunately not well preserved.

only the scanty division of the Merostoma (*Limulus*), the most northern of which occurs near Boston.

Of the essentially aquatic classes (or subclasses, according to the differences of system) of animals, we find that eleven, namely the Polycystineæ, Anthozoa, Acalephæ, Ctenophora, Siphonophora, Echinodermata, Tunicata, Brachiopoda, Pteropoda, Heteropoda* and Cephalopoda are exclusively marine, and the same number, namely, besides the forms already referred to, the Infusoria and Rhizopoda, the Hydroid polypes, Rotatoria, Bryozoa, Turbellaria, and Annelida, are common to both media, amongst which, however, the very numerous sections are purely marine (Sertularina, Bryozoa Stelmatopoda†, and the numerous, very highly developed order of the Annelida), whilst the sections proper to the fresh water are less rich in species, like the freshwater Polypes and Bryozoa (*Hydrina* and Bryozoa Lophopoda) and the *Planariæ* in the most restricted sense.

The Batrachia furnish the only example of a class of animals which is entirely wanting in the sea, and yet they are water-breathers, at all events temporarily: we are acquainted with marine Tortoises, marine Lizards (Darwin's *Amblyrhynchus cristatus* upon the Galapagos Islands), and marine Snakes (*Hydrophis*), besides the notorious Norwegio-American one, but, in spite of Seba and Schiller's 'Taucher', not a single Sea Toad or Sea Newt. Of the strictly air-breathing classes, lastly, certain representatives live constantly in the sea; of the Birds and Insects only a few venture temporarily into and under the water, both fresh and salt, but live essentially above its surface‡; amongst Insects, we have here especially the small, apterous, Carabideous Beetle

[* The author has previously regarded the Heteropoda as forming a portion of the class Gasteropoda.—TRANSL.]

† According to Dumortier and Van Beneden, however, the freshwater genus *Paludicella* belongs to this group.—[According to Professor Allman ('Monograph of the Freshwater Polyzoa,' Ray Society, 1856), both *Paludicella* and *Urnatella*, although freshwater genera, belong to the group above mentioned; whilst on the other hand, the marine genus *Pedicellina* appears to have a bilateral lophophore, which would cause its location amongst the freshwater forms. *Fredericella* also, a freshwater genus, possesses a funnel-shaped lophophore. Professor Allman's classification, in which the two orders of Polyzoa are distinguished by the presence or absence of an epistome, or lobe in the vicinity of the mouth, does not get rid of this appearance of marine forms in fresh water and *vice versâ*.—TRANSL.]

[‡ The author here seems to have forgotten the existence of whole families of Beetles and Bugs, which live habitually beneath the surface of the fresh water, whilst the larvæ of many of the former are even adapted to aquatic respiration. The larvæ of a great proportion of the Neuroptera also are strictly aquatic, and those of many Diptera live in water, although most of them breathe air.—TRANSL.]

(*Blemus fulvescens**), observed by Audouin, which remains concealed under stones during the flood-tide, and lives in places which are not left bare by every ebb; the other so-called marine Insects generally live only in brackish water, or roam about upon its surface, like *Halobates*, which is analogous to our *Hydrometra*†. As regards the Arachnida, the answer to the inquiry concerning marine forms, depends upon whether the *Pycnogonidæ* be included with them; the most recent and important authorities answer this in the affirmative. Amongst the Myriapoda, the occurrence of *Glomeris ovalis* in the sea is very problematical; at any rate, it does not live *in Oceano Europæo*, as Linnæus stated, nor are we acquainted with any freshwater Myriapoda.

For the classes, therefore, the number of the exclusive and common ones would be nearly equivalent. Of the seven primary types of the animal kingdom, on the contrary, only one, that of the Echinodermata, is exclusively marine; the others are common to the sea and fresh water, and the majority (4) also to the land: none of them are wanting in the sea. We may therefore establish the general proposition, that from the agreement in family of an animal of unknown origin, with another, of which the origin is known, we may in most cases (in the Crustacea in three-fourths, in the Mollusca in nearly nine-tenths) arrive at a probable (inductive) conclusion with regard to the derivation of the unknown form; and that the same applies for a fraction of the orders and classes, which often rises to the half of the primary type to which they belong, and for the Echinodermata‡ even to unity.

On the other hand, descending in the systematic scale, only an inconsiderable number of genera (in the modern sense = groups of species) are common to both media, even in the Fishes probably not more than 1 per cent.; and with regard to species the number falls to 0 in the Mollusca and Crustacea, except some cases which are still doubtful (*Paludinella thermalis* or *acuta, Gammarus locusta*); amongst Fishes, not only is the occurrence of *Gasterosteus trachurus* in the North Sea asserted by all the ichthyologists of that region, from Gronovius to Nilsson,

[* This Insect forms the type of Leach's genus *Aëpus*, of which a second species, the *Aëpus Robinii*, has lately been discovered on the coasts both of France and England. Besides these, a considerable number of Beetles, principally belonging to the extensive group of the Brachelytra, so many of which are singular in their habits, are found upon our shores in very similar positions.—Transl.]

[† Or rather, *Gerris*.—Transl.]

[‡ This can only hold, with regard to the Echinodermata, if we regard them, with the author, as representing a distinct primary type of animal structure; this, however, is by no means generally admitted.—Transl.]

but we also find, as a peculiar phænomenon, the migration of marine Fishes up the streams, in order to spawn, and, more rarely, that of river Fishes into the sea for the same purpose (the Eel; see Spallanzani's observations in Commachio, G. von Martens' Italien, ii. p. 334). Here therefore they are even the same individuals which alternately inhabit the two media; and perhaps this is not all, for it is said of several lakes that fishes which have immigrated into them from the sea are unable to find their way back, in consequence of the deficiency of current, and that they remain, as well as their posterity, in the fresh water; and on the other hand, Nilsson in his Scandinavian Fauna, in referring to our Shad (*Alosa*), does not say a word about its ascending into the fresh water, but, on the contrary, states that, according to the observations of Malm, it spawns between the rocky shelves of Gothenburg (Götheborg's skärgard).

Marine Mammalia also sometimes ascend the rivers, but with less regularity, and principally following the migratory Fishes, as was observed by Simpson* to be the case with Seals in the Oregon river as far as the rapids of Les Petites Dalles. Whether the common Seal which, according to E. Boll†, was killed in the Elbe near Dessau, is to be referred to this category, or whether it was one that had escaped from human custody, remains doubtful as a single case at such a distance from the sea.

The great richness of the sea is explained not only by its greater extent, but also by its more uniform temperature. The fresh waters stand in the same relation to it, as a continental to an insular climate; their alternation of temperature is the principal hindrance to their becoming populous, and this attains its maximum by freezing in the colder zones; with the increase of temperature the populousness of the fresh waters increases, but is still limited in the subtropical zone by partial desiccation. In the tropical zone, the conditions of temperature of the fresh waters approach most nearly to those of the sea, and with them their populousness.

BIBLIOGRAPHICAL NOTICES.

The Natural History of the Tineina. By H. T. Stainton, assisted by Prof. Zeller and J. W. Douglas. Vol. II. 8vo. London: Van Voorst, 1857.

After an interval of nearly two years, we have to call the attention of our readers to the appearance of a second volume of this highly

* Narrative of a Journey round the World, 1841–42.

† Archiv des Vereins für Naturkunde in Mecklenburg, 10 Heft, 1856, p. 73.

interesting entomological work, of the first volume of which we gave a notice in our Number for March 1856. As the present volume agrees exactly in all essential particulars of plan and arrangement —in its curious polyglot nature, the arrangement of its four languages in parallel columns, and the division of the subjects into sections—with its predecessor, there is no necessity for our referring to these peculiarities in detail;—in their excellences, as in their defects, the two volumes are identical.

In accordance with the general plan of the work, the present volume again contains the natural history of twenty-four species of Tineina, with full descriptions of the insects in all their stages, and a detailed account of their synonymy, illustrated by numerous figures upon eight beautiful plates. The latter are perhaps hardly so spirited in execution as those from the pencil of the late William Wing, which were published in the first volume; but in other respects they are highly satisfactory, and reflect the highest credit upon the artist and engraver, Mr. G. W. Robinson.

The twenty-four Moths which Mr. Stainton has selected for investigation on the present occasion all belong to the genus *Lithocolletis*, the species of which were for the most part arranged under the genus *Argyromiges* by Curtis and Stephens and the older British entomologists. The genus is a very extensive one, including, according to Mr. Stainton's summary in the commencement of this volume, no less than seventy-six known species. They are all of minute size, some of them amongst the smallest of Lepidopterous insects, but at the same time many of the species exhibit a most brilliant appearance from the presence of metallic silvery or golden markings upon the anterior wings. Their larvæ, like those of *Nepticula* and *Cemiostoma* described in the first volume, are leaf-miners; but they would seem to disfigure the leaves in which they take up their abode far more than those of the genera just mentioned, for their mines usually form broad blotches, and Mr. Stainton tells us that, "owing to the exertions of the larva, or to the natural shrinkage of the silken carpet which it spreads over the cuticle, this latter gets drawn into several folds, causing the opposite side of the leaf to assume a curved form, and by the pucker in the leaf thus produced, the larvæ obtain a convenient and capacious habitation." When full-grown the larvæ undergo their change to the pupa state in the interior of their mines, rarely spinning a firm cocoon, although some of them, "apparently aware of the weakness of the defences provided by their own silk, carefully cover the cocoon over with the grains of excrement, so that hardly any of the silk is left exposed." The species are for the most part confined to particular plants, a few only being less nice about their diet; but trees, shrubs and herbaceous plants are alike liable to their attacks, although the majority seem to prefer plants of a woody nature.

In his general observations on the genus, Mr. Stainton, as before, gives a summary of all the species belonging to it, but this does not contain short characters, such as were given in the first volume; and he also carries out his ideas of an Entomological Botany, by furnishing

his readers with a systematic analysis of the plants on which the different larvæ feed, the name of each plant being accompanied by a list of the species which have been found on it.

The Entomologist's Annual for 1858. London. John Van Voorst. 12mo.

The Entomologist's Annual is another book for which the British entomologist is indebted to the energetic exertions of Mr. Stainton. It is now in the fourth year of its existence, and seems to us to have acquired more vigour since the appearance of the first of the series; that is to say, the editor appears to have given up somewhat of his original notion, that in order to obtain success, an Entomological Annual must contain a certain amount of light matter, which, unfortunately, has too general a tendency to degenerate into trash.

In the 'Annual' for 1858 we meet with scarcely an indication of this, the greater part of its contents being of a nature to be really interesting to the student of British Entomology.

Besides the usual lists of new British species of Coleoptera, Lepidoptera and Aculeate Hymenoptera, discovered in the course of the year just elapsed, contributed by Mr. Janson, the Editor, and Mr. F. Smith, we have a series of notes on British Geodephagous Beetles by the Rev. J. F. Dawson, and on the caterpillars of the Saw-flies by Mr. Westwood (the latter intended especially for the use of young collectors of Lepidoptera, to save them the trouble and mortification of rearing a number of supposed caterpillars and getting nothing but Saw-flies for their pains),—questions and enigmas upon points connected with the natural history of the Tineina, and other Lepidopterological questions,—and a most warlike paper, entitled "Notes on Ants'-Nest Beetles," by Mr. Janson (in continuation of an interesting memoir on the same subject in the 'Annual' for last year), in which some offending Coleopterists are attacked in a style worthy of the rival Eatanswill editors immortalized in the 'Pickwick Papers.'

But perhaps the most important paper in the volume is the "Synopsis of the British Planipennes," by Dr. Hagen, which contains short characters of all the known British genera and species of the true Neuroptera with a perfect metamorphosis, and also of a few European forms, which Dr. Hagen considers will probably be found in this country. The most important of these are the Ant-lions (*Myrmeleon*), one of which, it appears, was described by Barbut as a British insect; and the author thinks it by no means impossible "that Southern Ireland may possess the extraordinary *Nemoptera Lusitanica*." The last year's 'Annual' contained a "Synopsis of the British Dragon-flies," also from the pen of Dr. Hagen; and there can be no doubt that the publication of such papers as these must add greatly both to the usefulness and prosperity of this little book.

The Handbook of British Ferns. By T. Moore, F.L.S. Third Edition. London, 1857.

Four years since we noticed at some length the second edition of this excellent book, and it is therefore unnecessary to occupy much space in announcing the publication of this fourth edition, which possesses all the valuable qualities of its predecessor and has been carefully revised throughout. There is very little change in its author's opinion concerning the limits of species or nomenclature. The *Athyrium rhæticum* is again joined to *A. filix-fœmina. Lastræa Fœnisecii* takes the name of *L. æmula,* from the discovery that it is certainly the *Polypodium æmulum* of Aiton: thus the long controversy concerning the proper name of the plant is set at rest in a satisfactory manner.

But the most marked characteristic of this edition consists in the immense number of forms which are described in it. Most of these have very little interest for the botanist, although collected with avidity by the cultivator. Mr. Moore has usually pointed out with care which of the forms are deserving of botanical attention; nevertheless it seems to us that he might well have divided the several species into their true varieties (if we may so call them) and arranged under each the less definite forms. Thus the botanist would have benefited, without any injury to the cultivator.

As in the former editions, much attention is paid to the mode best adapted for the culture of the plants.

The book is our best work upon British Ferns, and will be useful to all those who take an interest in them.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 14, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

On Stoastomidæ as a Family, and on Seven proposed New Genera, Sixty-one New Species, and Two New Varieties from Jamaica. By the Hon. Edward Chitty.

Stoastomidæ! When I first open my cabinet of this Family to the spectator, two observations are generally made. The one, "How minute! how could you trouble yourself with such specks! they are not worth seeing, for we cannot see them." Then follows, "Well, they *are* very wonderful; but how did you collect them?"

To the first observation I answer, "True, they are but specks, and have very much injured my eyesight; but they *are* worth seeing under the microscope; for they are worthy to rank, and must rank, in point of sculpture, with the most wonderful and beautiful shells known to conchologists, and most of them are most worthy of a sculptor's or designer's study." Among the *Helices, Pupæ, Achatinæ, Cylindrellæ, Bulimi,* &c. there are plenty of *minute* species almost microscopic, and interesting enough; but, under the microscope, these only improve in size, and no further beauties are unfolded, and little further interest is given to them by its use. The

Stoastomidæ, however, are not only wonderful for their minuteness, and from the knowledge that, however minute, they are part of an animal, perfect in its anatomy as that of the largest shell; but the form and sculpture of each species are so marked, that the microscope brings out in each, new beauties and new wonders, entitling them to rank among the most wonderful works in animal creation. And to say the *least* of these *Stoastomidæ,* "They *are* shells, and beautiful ones too, and are not only worthy, but *must,*—being known to exist, —be in every cabinet that pretends to the smallest degree of perfection or completion."

To the second I shall reply by practical information which I think will be valued.

"Easily attained, little valued," may be taken as a good general maxim. But my love for this family arose from a difficulty; and as it involves the history of *Stoastoma,* I may be permitted to relate it.

In the winter of 1848–49 the late Prof. C. B. Adams paid me a visit in Jamaica; and looking over a limited collection, he observed that which is now known as *Stoastoma pisum.* The singularity of its semicircular mouth was noticed by him, as it had been by me; but it then stood alone, and he put it on one side to be described as *Helicina pisum,* hesitating to give it generic importance. He next visited Manchester parish, the principal habitat of *St. pisum*; and meanwhile I, in my own garden in St. Thomas in the East parish, close to Yallahs Hill, found a minute shell with a somewhat similar mouth, about which I corresponded with him. This turned out to be that wonderful and beautiful speck *St. Wilkinsonæanum.* He again in Manchester collected more specimens of *S. pisum* and other species of the family, and, first under the proposed generic name of "*Hemicyclostoma,*" the species were finally placed under the generic name of "*Stoastoma*" at the suggestion of Dr. A. A. Gould. While Adams was still away from me, as I was examining my only specimen of *S. Wilkinsonæanum,* it dropped from my hand—fortunately on to the floor-cloth,—and I did not recover it till after a full hour's careful search. This showed me the folly of being satisfied with the possession of one specimen only, where others *might* be obtained; and I determined to make a vigorous search for more. I ransacked my garden and all round, in vain; for, as I now conclude, it had been brought there accidentally, perhaps by a bird; till at last I crossed a deep ravine, a streamlet at the bottom of it, and got to one side of what we call "Little Yallahs' Hill," which stands a good half-mile crow-fly distance from my garden; there I found a spot, a slope on the hill-side, with crumbling fine dirt running, or sifting as it were, down it. There I *first* found *Geomelania Greyana* (described as *Cylindrella Greyana,* Contrib. Conch. p. 82, till I made out the operculum of that genus). These were so numerous, and many so broken, that I put handfuls of the fine dirt into a small bag for home examination. The result was, plenty of *St. Wilkinsonæanum,* and other new species at the same time.

The plan of collecting all minute shells, beyond this "bagging" of dirt, is, to have a small zinc or tin tray about 9 inches long and 3 wide, with sides turning up all round half an inch high. I put

about half a teaspoonful of dirt, such as I have alluded to, into it. Holding the tray at each end, and tilting it the furthest side downwards, shaking it lightly backwards and forwards, right and left, end to end, causes the dirt to fall and spead somewhat evenly along the outer edge ; then, *levelling* the tray, a slight jerk from *side* to *side* of the tray causes the whole of the dirt to spread pretty evenly over the tray's surface, and exposes every minute object to view, with the aid of strong spectacles or a lens. A pointed wetted camel's-hair brush takes up and may deposit the minute subjects into a pill-box, or other receptacle, for future examination. The formation of Jamaica being mostly tertiary limestone, out of about a quart of such dirt as this, I have taken dozens and dozens of minute specimens of no less than thirty-one species, besides larger ones, which the naked eye could well see—probably upwards of fifty species from one quart of dirt altogether !

I am about to describe sixty-one new species, which, added to those described by Adams, make the total of eighty belonging to Jamaica. Yet let it not be imagined for one moment that I consider these are all that inhabit the island : on the contrary, I incline to think that that number might be doubled or trebled were the whole land explored.

I consider that the range of each species is very limited, and that each spot of land suitable to them will contain distinct species which are not to be found elsewhere. *S. pisum* is a remarkable exception. That shell occurs in the Back Woods or highest mountains in the north of Manchester ; at Porus, say ten miles "crow-fly" distance on the east border of Manchester ; at Moreland and "Bull dead" in Manchester, say about the same distance south, near the western border : and again it is found at Accompong Town in St. Elizabeth's parish, at (say) twenty-five or thirty miles to the west. And it is curious to observe, that, taking Manchester back woods as the focus, I have collected and received shells from many intermediate spots between it and Porus and Moreland, and Bull dead and Accompong town, without getting one *St. pisum,* although many shells equal or smaller in size of other genera and species. But take any other of the *Stoastomidæ,* and probably you will search for it in vain *outside* of a circumference of three-fourths of a mile from the spot where it was first found. Each such spot will contain probably as many as four or six or seven species ; but to that spot all those species are confined. In the following descriptions it will be seen that the habitat of six species is certainly "Peace River :" and that of eight species as certainly Yallahs Hill. The latter I have personally explored ; one of my residences was near by, and I repeatedly visited it ; and I have no hesitation in saying that none of those eight species are to be found at half a mile either way. There are hundreds of spots of this kind in the island never trodden by human foot, and therefore there is no knowing how many *Stoastomidæ* and other minute shells might yet be found, or how many of other genera, from large to small, may yet be added to the terrestrial conchology of Jamaica. The number of unique specimens in my cabinet tells us this truth,

I having been a collector *in situ* for years by myself or my black deputies, who are rarely to be bribed into a repetition of a visit to a strange and unwelcome spot.

I must here record my great thanks to my friend Dr. S. Livesay for the personal assistance he has afforded me with some of these troublesome shells; but more especially, not only for the loan of his microscope throughout the labour, but for his most ingenious contrivances, which have been of the greatest help in the examination and measurement of shells, enabling me, by aid of one, to examine all parts by a rotatory motion, and at the same time to readily compare one shell with another; and by aid of another, on the sliding-scale principle, to measure by the thousandth part of an inch with the nicest accuracy and with the greatest facility. Future describing conchologists would do well to make inquiries of that gentleman.

In order to give a clearer understanding of my descriptions, it is well to state how I have proceeded to examine the shell. Dr. Livesay's apparatus consists of a plate on which a battery (as it were) of large pins may be placed in grooves, and kept firm by an upper plate, moveable at one end, so as to admit of removing them when required, and fixed at the other by a hinge. These pins are revolved in their grooves by the fingers, there being a small piece of rounded cork stuck on the point of the pin to lay hold of. The shell is gummed on to the pin's head, so that the plane of aperture is parallel to the length of the pin, and the axis of the shell at right angles with it. In this position the operculum, if there, or if not, the inside of the aperture, and also the apex and umbilicus, and indeed all parts of the shell, except the point of attachment, can be brought under the microscope by revolving the pin.

Next, let me explain any new terms I may have used. In speaking of "above" or "below," I always consider the apex the uppermost, and the umbilicus the lowermost part. In speaking of "right" or "left," the outer edge of the aperture is considered to be on the right hand.

In pursuing the examination, we give in succession *Form* and *Colour*. Those two are manifest. *Sculpture*: we commence by describing the sculpture of the last whorl, and calculate from below the suture downwards towards the umbilical region at about a quarter from the aperture, or the last quarter or third of the last whorl. *Spiral carinæ* are sculptured raised lines, transverse to the axis or column of a shell. The *spire* and its outlines are self-evident. *Whorls* are counted from the aperture upwards; from that part to where it is opposite or attached to, what is termed, the body-whorl, forms one whorl, and so on upwards, the whole, half, third, or quarter being determined by the exact termination of the appearance of a suture at the nuclear apex. The *aperture*, or mouth, though not audibly, speaks its own shape, &c. *Labrum* in *Stoastoma* is the edge of the right-hand portion of the aperture, extending from the suture, as it were, above, round on the right, till it finishes its curve below; the labium being the almost straight part on the left. Labral and labial, coined words, refer to those parts of the edge of the aperture, &c.

Labrum "double" denotes a more or less fine, sharp groove close behind the very verge of the labral side of the aperture; and it shows that some at least of *Stoastomidæ* have peristome and peritreme, though never prominent or expanded as in *Choanopoma fimbriatulum*, *C. Chittyi*, and the like.

The "*labral lamella*" is a term we adopt, equivalent to Adams's "spiral lamella," "lamellar spiral keel," "spiral carina continued into the lower extremity of the labrum," &c.; or the "lamelliform keel," "basal margin continued," &c., "small lamella," "raised lamella," &c. of Pfeiffer, Cat. Phan. I call it "*labral*" lamella, because it appears to me to grow out of the labral side of the shell, one specimen of *Lewisia Agassiziana* in progress of development clearly denoting the fact. It answers to the "*umbilical keel*" of some of the *Cycloti*. In "*measurement*" of height the axis is placed at right angles to the base, so that "height" signifies distance between two parallel lines, the apex touching one, and the extreme lower edge of the aperture touching the other, the axis being at right angles. "Greatest breadth" measures from the edge of the aperture about the periphery to its extreme opposite at the other side of the last whorl, the axis being still at right angles. "Least breadth" is when three parts of the last whorl touch two parallel lines, that is, the plane or edge of the aperture, the back of the last whorl, and narrowest part of it close to the aperture, or the penultimate whorl.

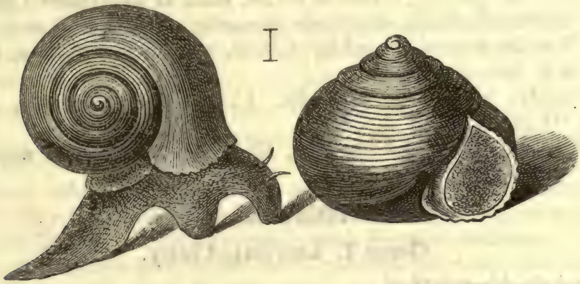
With, then, the one species from Polynesia, *Electrina succinea*, the total of *Stoastomidæ* amount to 81 species known; and I proceed to propose an entirely new arrangement of them. Professor Adams foresaw the necessity and propriety of it. In his 'Monograph of Stoastoma,' p. 4, occur the following passages:—"The value of this genus is equal to that of the Lamarckian genera of *Cyclostoma* and *Helicina*. If these should be generally received as families, subdivided into several genera according to the plan of Dr. L. Pfeiffer, it will be entitled to constitute a distinct family, STOASTOMIDÆ. Some of the characters rarely, if ever, occur in other genera, while the specific differences consist partly in slight modifications of these characters. Such are the blunt but not reflected edge of the labrum and the spiral lamella issuing from the umbilicus. The genus has thus a very obvious type, quite distinct from any hitherto discovered. An affinity with the *Cyclostomidæ* is established between *Aperostoma* (Troschel) and the depressed and discoidal species of *Stoastoma*." "Its affinity with the *Helicinidæ* is established between *Lucidella* (Swainson) (? ?), and some of the conical species, as *S. Redfieldianum* and *S. Leanum*, by their general form and sculpture, and by the form of the base. But observations on the animals will be of more value on this subject. We were not so fortunate as to obtain living specimens. While preparing this Monograph, a correspondent informs us that *S. pisum* when alive is sea-green."

In raising *Stoastoma* into a family, I am thus justified by Professor Adams, and only carry out his views in calling it, Family *Stoastomidæ*, Adams.

Fortunately I happen to be "the correspondent" who found the shell *S. pisum* in "a living state;" when it is, and continues after, if so taken, of a "sea-green" colour externally. I have also examined the outward form of the animal. The following are my rough original notes made long ago upon it:—

"STOASTOMA PISUM.

"The animal seems to have but one pair of horns, and is thus shaped.



[The drawing supposes the animal to be in motion.]

"*Horns* short, thick at base, and pointed. Mollusk black, or of the darkest bottle-green. Seems to aid its progress by its snout."

So different, then, is the animal and shell from either *Cyclostomidæ* or *Helicinidæ*, that with propriety we may take it out of either family and place it as a distinct family, STOASTOMIDÆ, Adams, which I divide into the following genera; adding, however, to Adams' description, "all the species"—"are sculptured with spiral lines;" this, "except very rarely, as in the instance of *S. Philippianum*;" and it is right also to mention, that this family possesses the habit of absorbing part of the internal structure of their shells, as pointed out by Mr. Bland in a paper read before the Lyceum of Nat. Hist. N. Y. (see Annals), Feb. 27th, 1854.

The genera will stand thus:—

First, those most singular shells having, as it were, two mouths, such as the only two hitherto known, *St. Agassizianum*, Ad., and *St. Philippianum*, Ad., demand a section to themselves. These and two others I shall call Genus LEWISIA, in compliment to Prof. L. Agassiz.

Secondly, those beautiful ones, like *St. Gouldianum*, with long projecting termination of the last whorl, and such decided sculpture of a few (four or six) strong transverse striæ, with fine ones intervening —being all of subdiscoidal form ("*Gouldia*" being preoccupied among marine shells), I shall call Genus "WILKINSONÆA," in honour to the memory of the lady whose name it bears, as well as to that of Adams, it being the second shell of the kind he described: with a subdivision for those devoid of the lengthened last whorl, but with similar sculpture.

Thirdly, those singular shells with somewhat depressed spire, sub-

angulated on the upper part of the last whorl, then *quasi* straight or flat at the periphery, and then subangulated again at the base, Genus "FADYENIA," in memory of the lamented author of the 'Flora of Jamaica.'

Fourthly, those shells which represent the *S. pisum*, the first type, and are subglobose, STOASTOMA.

Fifthly, depressed conic shells, like *S. Chittyanum*, Genus METCALFEIA; *S. Chittyanum* being the only one described by Adams.

Sixthly, the globose, discoidal forms, such as *Stoastoma Cumingianum* (that name being elsewhere preoccupied), I call Genus "PETITIA," as the second named by Adams, and in compliment to M. Petit de la Saussaye.

Seventhly, globose conic shells, like *S. Lindsleyanum*, I call Genus "LINDSLEYA."

And, eighthly, the subdiscoidal, like *S. Blandianum*, I nominate Genus "BLANDIA."

STOASTOMIDÆ, Adams.

Genus I. LEWISIA, Chitty.

Quasi *double-mouthed.*

LEWISIA AGASSIZIANA, Chitty. See *Stoastoma Agassizianum*, Ad. Cont. Conch. p. 158; Cat. Phan. p. 234.

The habitat of this shell is near Ackendown, Westmoreland. The "deposit," of which Adams speaks, is still remaining in one of my specimens (the original type), and beyond a doubt is the operculum, like many others I shall describe. It is so fixed in the aperture, that I will not risk its breakage in removal, and so I cannot fully describe it. It is excessively concave in its centre, continued on the labial side in a long, broad, smooth, shining convex plate, shaped like a tongue, and extending almost and sinking into the opposite extreme of "the spiral lamella excessively developed and soldered," &c., as described by Adams.

LEWISIA PHILIPPIANA, Chitty. See *Stoastoma Philippianum*, Ad. Cont. Conch. p. 158; Cat. Phan. p. 235.

Operculum, still —— ?

Hab. Burnt Hill, near Ackendown, Westmoreland, *non* Ackendown.

LEWISIA WOODWARDIANA, Chitty.

Hab. —— ? Hanover (unique).

Form, subdiscoidal. *Colour*, very pale horn. *Sculpture*, 14 spiral carinæ, widely apart, rather blunt; about 4 visible on the penult whorl, lines of growth well defined. *Spire*, very slightly elevated, with concave outlines. *Whorls*, 4, very slightly rounded, with a lightly impressed suture; last whorl well rounded. *Aperture*, well detached from the body-whorl, slightly depressed and slightly constricted, semielliptical. *Labrum*, double, slightly thickened, reflected

and rounded off, smooth, plain, not scolloped. *Labium*, straight, edge produced angularly in its centre, and much rounded and reflected towards the umbilicus. *Labral lamella* (see *ante*), rises somewhat abruptly from the labrum, forming a cavity longer in its interior than the aperture, and joins the last whorl below, beyond the umbilicus, by rather a sharp inflection upwards; so that from its junction to outside the labium is not wider than the lesser diameter of the aperture; exteriorly very convex, with a deep suture between it and the last whorl beneath. *Umbilicus*, concealed. *Operculum*, —— ?

Height 0·057, greatest breadth 0·083, least breadth 0·07.

Named in compliment to S. P. Woodward, Esq., British Museum, author of 'Manual of Recent and Fossil Shells,' &c.

Lewisia MacAndrewiana, Chitty (unique).

Hab. Near the Botanic Garden, St. Andrew's. The smallest *Stoastoma*!

Form, subdiscoidal. *Colour*, pearl white, semitransparent, most likely therefore a young shell. *Sculpture*, 25 equidistant fine spiral carinæ. *Spire*, much depressed, with convex outlines. *Whorls*, $3\frac{1}{4}$, well rounded, with rather a deep suture; last whorl well rounded. *Aperture*, well rounded, more than a semicircle, very slightly expanded below; a little detached from penult whorl and very slightly depressed. *Labrum*, slightly double, thin, reflected very shortly, white, shining, smooth, planular. *Labium*, well detached from penult whorl, rather lower than plane of labrum, very slightly curved to the right below. *Umbilicus*, N.B.! apparently very shallow, but covered by an externally convex white callosity, which proceeds from behind the upper end of the labium and covers the umbilicus, and is attached to the body-whorl all but at its extreme left; whereunto it may, in older specimens, be entirely soldered. This, though incomplete at the aperture, bears the characters of a complete shell. The *labral lamella* is very slightly produced, rounded at its edge, quite separate from the above callosity on the right, but apparently joining the exterior of it on the left, round the umbilical region.

Height 0·024, greatest breadth 0·046, least breadth 0·036.

I have some doubts as to placing this unique specimen in this subgenus, but think that, from the callosity over the umbilicus and its seeming immaturity, and the appearance that the labral lamella is not complete, it will, from older or other specimens, be found to be properly classed.

Named in compliment to Robert MacAndrew, Esq., so well known from his valuable dredging operations.

Genus II. Wilkinsonæa, Chitty.

§ 1. *Shell subdiscoidal; last whorl extraordinarily produced. Sculpture, a few strong and many fine carinæ.*

Wilkinsonæa Wilkinsonæana, Chitty.

Hab. Yallahs Hill, East face.

The symmetrical form and beautiful sculpture induce me to rank

it first. It was also the second *Stoastoma* found, though not described till long after *S. Gouldianum*, the latter in Sept. 1849 and the former in Oct. 1850; for Adams at that time was inclined to treat it as a mere variety! *Stoastoma Wilkinsonæanum*, Ad. Cont. Conch. p. 148; Cat. Phan. p. 233.

Wilkinsonæa Gouldiana, Chitty.

Hab. The backwoods in Manchester's highest mountains, northern region. *Stoastoma Gouldianum*, Ad. See Mon. Stoast. Adams, 1849, p. 5; Cat. Phan. p. 232.

Var. *a.* Ad.

Same habitat.

Labrum not so much produced above. *Aperture* more cupped and expanded in proportion. (See, as above.)

Var. *b.* Chitty.

Hab. Trelawny, still further north.

Is much smaller than var. *a.*, and labrum and aperture are miniature of *S. Gouldianum* proper.

Height 0·035, greatest breadth 0·073, least breadth 0·058.

Wilkinsonæa Schomburgkiana, Chitty.

Hab. Moreland, Manchester.

Form, subdiscoidal. *Colour*, semitransparent very pale horn. *Sculpture*, lines of growth very apparent; counting from the suture, there are five less prominent and then one very prominent rounded spiral carinæ, three less and one very prominent, two less and one very prominent, two less and one prominent, three less and one very prominent, and eight less, gradually becoming finer round the umbilicus: visible on the upper whorls, three less, one prominent and two less. *Spire*, much depressed, with considerably convex outlines. *Whorls*, $3\frac{2}{3}$rds, well rounded but flattened at the lower part; suture very lightly impressed. *Aperture*, constricted at more than the width of the last whorl from the labrum, about 0·015, and then convexly rounded externally and concavely internally; widely expanded, deflected below, subsemielliptical. *Labrum*, leaves the body at about 50°, very much thickened and reflected; pure white; deeply scolloped by the strong spiral carinæ, which form five blunted points. *Labium* *, nearly straight above, curved below abruptly to the right and then to the left back again; much below the plane of the labrum, joining it at about the constriction of the aperture above, but rising to the plane below. *Umbilicus*, narrow and deep. *Labral lamella*, very slightly rounded, and projecting at its junction with the labrum, narrow and slightly produced below. *Operculum*, very broadly margined all round by a wide convex fold and a raised lamella on the labral side like the capital italic *D*; very deeply concave, with, in the hollow, three or four rounded raised ridges crossing diagonally from right above to left below, which are finely decussated diagonally

* It is singular, that out of only ten specimens, every one should have the operculum which partially hides the labium.

from left to right, the labral side finely plaited, the lower left end expanding broadly, and folding over the lower part of the labium in thin plaits or laminæ; which plaits are continued on the lower side of the operculum. A very interesting shell.

Height 0·039, greatest breadth 0·074, least breadth 0·053.

Named in honour of Sir Robert Schomburgk, the celebrated traveller in Guiana, and great naturalist, &c.

Wilkinsonæa Abbottiana, Chitty.

Hab. —— ? Hanover.

Form, subdiscoidal. *Colour,* white, subtransparent, shining. *Sculpture,* five very strong spiral carinæ, with, at the periphery, two highly microscopic, scarcely visible, intervening between the strong lines; three rather stronger, below the lowest strong carina round the umbilicus; one strong on the upper whorls. *Spire,* much depressed, with convex outlines. *Whorls,* 4, very slightly rounded, with a light suture. *Aperture,* extraordinarily produced from the body-whorl, rather constricted far away from the labrum, and rather cupped inwards to the labrum; flattened above, expanded and depressed below, semielliptical. *Labrum,* extraordinarily produced and depressed at the uppermost strong spiral carina, slightly scolloped and pectinated at and by the other strong carinæ, reflected and thickened slightly. *Labium,* widely detached from the body-whorl, very little curved to the right below, very much below the plane of the labrum. *Umbilicus,* shallow and broad. *Labral lamella,* slightly and angularly spread out close to the labrum, then thin and narrow and not concealing the umbilicus. *Operculum,* most extraordinary, and who can describe it?! Very deeply concave in the middle, with a broad raised margin all round, very broad and much rounded on the labial side, which has a largely developed tooth-like horizontal plait or fold half-way down it descending into the hollow, and a much larger one proceeding from the lowest labial side, flowing, as it were, to the left well over the labial side, and also over the labium, not concealing the lowest part of the operculum, but showing the lowest part of the labial side to be broad and spreading,—trumpet-shaped. Unfortunately I possess but two specimens, only one having the operculum, which is so firmly fixed in the shell that I dare not further attempt its extraction, and therefore I cannot further examine its extraordinary structure.

Height 0·034, greatest breadth 0·066, least breadth 0·049.

Named in compliment to Captain George Abbott, of the R.W.I. Steam Mail Company's Service (at present commanding the 'Magdalena'), for his great care and attention in procuring and preserving specimens of natural history for the Zoological Society of London.

Wilkinsonæa Jardineiana, Chitty.

Hab. Swift River Head, St. George's.

Form, subdiscoidal. *Colour,* very pale horn. *Sculpture,* lines of growth visible; seven strong spiral carinæ, without intervening fine ones; three strong, on upper whorls. *Spire,* slightly elevated, with

concave outlines. *Whorls*, 4, moderately convex, with a lightly impressed suture; last whorl wholly detached from the penult, extending about one-third the widest breadth of the shell beyond it, and angularly and pointedly produced above. *Aperture*, slightly constricted about the point of attachment to the penult whorl, then bulging or swelling out and becoming slightly constricted at the labrum; semi-elliptic, but modified by the below-mentioned depression of the labrum, and production of the last whorl, and also, in a corresponding degree, on the lower side. *Labrum*, produced above to an extraordinary degree at the second carina, and there very much depressed or bent inwards, thickened and reflected; very slightly scolloped by the spiral carinæ. *Labium*, much detached from the penult whorl; upon a plane with the lower part of the labrum, but much below it above; slightly sinuate above, and very much so to the right at its junction with the labrum below. *Umbilicus*, moderately deep, only partially concealed by the *labial lamella*, which is narrow and shortly incurved towards the umbilicus. *Operculum*, —— ?

Height 0·024, greatest breadth 0·059, least breadth 0·042.

Named in compliment to my friend Sir William Jardine, Bart., of Applegarth.

Wilkinsonæa Greenwoodiana, Chitty.

Hab. —— ? Hanover.

Form, subdiscoidal. *Colour*, pale horn. *Sculpture*, lines of growth visible; three fine spiral carinæ and one strong, and so on until the fifth strong carina, below which, round the umbilicus, are six fine carinæ; on the upper whorls one strong in the centre of six fine carinæ. *Spire*, depressed with convex outlines. *Whorls*, $3\frac{2}{3}$, slightly convex, with lightly impressed suture. *Aperture*, separated from penult whorl in an elegant curved line, more than semicircular, rather flattened above and very slightly expanded. *Labrum*, spreading not very prominently above, white and smooth, slightly reflected and expanded about its centre, pectinated very slightly by four of the stronger carinæ. *Labium*, slightly detached from penult whorl; sinuous, thin, and slightly reflected; on the plane of the labrum below, much below it above. *Umbilicus*, moderately deep and narrow, well circumscribed by the *labial lamella*, which is sharply and slightly produced. *Operculum*, —— ?

Height 0·032, greatest breadth 0·054, least breadth 0·044.

Named in compliment to Major Greenwood, whose collection of shells from New Zealand was sent by him to the British Museum.

Wilkinsonæa Laidlawiana, Chitty.

Hab. Pool's Rock, Hanover.

Form, subdiscoidal. *Colour*, very pale green. *Sculpture*, 1st, 2nd and 3rd spiral carinæ, strong; 4th strongest; 5th, 6th and 7th strong; 8th strongest; 9th, 10th and 11th strong; 12th strongest; 13th, 14th and 15th strong; 16th strongest; 17th, 18th and 19th strong; 20th strongest; 21st and 22nd strong*er*; 23rd, 24th, 25th and 26th, round umbilicus, fine; the strong lines are all obsolete behind the aperture; on the upper whorls are 5 strong, 1 strongest,

and 2 stronger carinæ. *Spire*, slightly elevated, with convex outlines. *Whorls*, 3½, well rounded, with deep suture. *Aperture*, very slightly constricted at a distance from the labrum, and the strong carinæ become obsolete; thence, aperture well expanded; rather depressed above and expanded below; more than a semicircle. *Labrum*, very double, more so above than below; joins the body-whorl at the constriction by an angle of about 70°; rather strongly produced at the first strongest carina; deeply and broadly pectinated and scolloped between the strongest carinæ, namely the 4th, 8th, 12th, 16th, and 20th, making five points; slightly thickened and reflected; white. *Labium*, slightly reflected, rather thin, slightly curved to the right above and below; well detached from the body-whorl; below the plane of the labrum. *Umbilicus*, moderately deep, broad; little affected by the *labral lamella*, though it is equally and strongly produced all round. *Operculum*, shallow in the centre and very flatly concave, with two sharp diagonal carinæ across it, from right above to left below: labral side with a broad border and raised lamella: upper end, diagonally plaited from left above to right below, and lower end the same, only from right above to left below.

Height 0·036, greatest breadth 0·064, least breadth 0·048.

Named in kind remembrance of my bosom friend, Henry Laidlaw, Esq., Stipendiary Justice, Manchester, Jamaica.

§ 2. *Last whorl not strongly produced. Sculpture a few strong, and many fine carinæ.*

Wilkinsonæa Tappaniana, Chitty. See *Stoastoma Tappanianum*, Ad. Cont. Conch. p. 149; Cat. Phan. p. 233.

Hab. Peace River, Manchester.

Wilkinsonæa Hollandiana, Chitty. See *Stoastoma Hollandianum*, Ad. Cont. Conch. p. 149; Cat. Phan. p. 234.

Hab. The back woods of Manchester.

Wilkinsonæa Dysoniana, Chitty.

Hab. John Crow Hill, Portland.

Form, subdiscoidal or very depressed conic. *Colour*, very pale yellow. *Sculpture*, beautiful,—6 very highly raised sharp spiral carinæ, with about 11 very fine highly microscopic carinæ intervening in the first space below the suture, 9 on the second space, 7 on the third, fewer on the fourth and fifth, and very numerous beyond the sixth strong carina round the umbilicus. On the upper whorls, one strong carina in the middle, and one close above the suture, with a proportionate number of very fine intervening. *Spire*, slightly elevated, with very convex outlines. *Apex*, sharp. *Whorls*, 4¼, scarcely rounded, with very light suture; last whorl scarcely produced from the body-whorl. *Aperture*, very slightly constricted at the fauces, not expanded, except very slightly below. *Labrum*, pectinated and very slightly scolloped by the six strong carinæ, thin and sharp. *Labium*, detached from the penult whorl; on a plane with the labrum, very slightly rounded above, much below to the

right. *Umbilicus,* very deep and suddenly narrowed. *Labral lamella,* very strongly produced close to the labrum above, less prominent round the umbilicus. *Operculum,* slightly concave in the middle, with a deep broad margin all round, very fine granulations in the hollow, with (?) four very fine distant carinæ crossing diagonally from right above to left below.

Height 0·04, greatest breadth 0·066, least breadth 0·053.

Named in compliment to the memory of the late Mr. David Dyson of Salford, so well known for his zoological researches in Central America, Venezuela, &c.

WILKINSONÆA HANLEYANA, Chitty.

Hab. Pool's Rock, Hanover.

Form, subdiscoidal, or very depressed conic. *Colour,* pale horn. *Sculpture,* lines of growth, wide apart: 3 strong spiral carinæ; 4th, stronger; 3 strong; 8th, stronger; 3 strong; 12th, stronger; 3 strong; 16th, stronger; 2 strong; 19th, stronger; and 4 strong round the umbilicus. On the upper whorls, 3 strong; 1 stronger; and 3 strong. *Spire,* slightly elevated, with straight or very slightly concave outlines. *Whorls,* $3\frac{1}{2}$, well rounded with light suture. *Aperture,* much constricted behind the labrum, and then much dilated; depressed above and expanding below; subsemicircular. *Labrum,* double, slightly produced above; pectinated and slightly scolloped by the five stronger carinæ; attached to the body-whorl and produced at an angle of about 70°; slightly thickened and reflected. *Labium,* much lower than the plane of the labrum above; less so, below, moderately detached from the body-whorl; rather curved at both extremities. *Umbilicus,* shallow and broad, not affected by the labral lamella, which is fine and narrow throughout. *Operculum* ——?

Height 0·041, greatest breadth 0·061, least breadth 0·047.

Named in compliment to Sylvanus Hanley, Esq., author of 'British Shells,' &c.

WILKINSONÆA BENSONIANA, Chitty.

Hab. Roaring River, Westmoreland.

Form, subdiscoidal. *Colour,* rather dark brown. *Sculpture,* six prominent sharp spiral carinæ intermingled with eighteen less strong: on the upper whorls, one strong between about six less strong. *Spire,* very little elevated, with slightly concave outlines. *Whorls,* $3\frac{1}{2}$, slightly rounded with a very light suture. *Aperture,* semicircular, depressed above in the uppermost third, much expanded below. *Labrum,* much and pointedly produced above, at an angle of about 75° from the body-whorl, white, slightly thickened and reflected, angulated, not pectinated, by all five points of the sharper carinæ. *Labium,* rather curved below, much detached from body-whorl, on a plane with the labrum at the lower end, much below it above. *Umbilicus,* rather deep and broad. *Labral lamella,* regularly produced, strong but narrow, subangularly pointed close at the labrum. *Operculum,* moderately concave, serpentine on the labial side, with a groove on the labral side.

Height 0·027, greatest breadth 0·049, least breadth 0·038.

Named in compliment to W. H. Benson, Esq., who has contributed so much to our knowledge of Indian land-shells.

Wilkinsonæa Moussoniana, Chitty.

Hab. Yallahs Hill.

Form, subdiscoidal. *Colour*, white, semitransparent. *Sculpture*, 22 lines, four of which are very slightly stronger than the rest, lowest most strong and prominent; on the upper whorls, 7. *Spire*, slightly elevated, with convex outlines. *Whorls*, $3\frac{1}{2}$, slightly rounded, with a light suture. *Aperture*, slightly expanded and depressed below, more than a semicircle. *Labrum*, thickened and reflected, double above, very slightly scolloped by the four stronger carinæ, or rather the labrum is produced in straight lines to meet each stronger carina, forming three straight lines scarcely pectinated, in octagonal shape, moderately and roundly produced above from the body-whorl. *Labium*, rather curved, below the plane of the labrum above, moderately detached from the body-whorl. *Umbilicus*, deep. *Labral lamella*, sharply, finely and uniformly produced. *Operculum*, slightly concave, smooth, with ? two strong rounded carinæ vertically crossing the hollow.

Height 0·035, greatest breadth 0·058, least breadth 0·042.

Named in compliment to Prof. A. H. Mousson of Zurich, Switzerland.

[To be continued.]

MISCELLANEOUS.

On some Eggs of Insects employed as Human Food, and giving rise to the formation of Oolites in Lacustrine Limestones in Mexico. By M. Virlet d'Aoust.

The author states that the bottom of the lakes of Chalco and Tezcuco, which border the city of Mexico, consists of a calcareous mud, of a whitish-grey colour, the formation of which is still in progress, as indicated by the remains of human industry which occur in it. Whenever he observed these calcareous deposits uncovered by water, he was struck with finding that they constituted oolites exactly identical in appearance, and in the form and size of the grains, with those of the Jurassic system. On mentioning this circumstance to Mr. J. C. Bowring, director of the salt-works of Tezcuco, in whose trenches the oolitic structure was clearly exhibited, he stated that these oolites were formed by the eggs of insects, which are subsequently incrusted by the calcareous concretions constantly deposited by the waters of the lake.

It appears, from the further statements of the author, that, especially in October, the lake is haunted by millions of small flies, which after dancing in the air, plunge down into the shallower parts of the water to a depth of several feet, and deposit their eggs at the bottom. The eggs of these insects are called *Hautle* (Haoutle) by the Mexican Indians, who collect them in great numbers, and with whom they appear to be a favourite article of food. They are prepared in various ways, but are usually made into cakes, which are eaten with a sauce flavoured with chillies.

To collect the eggs, the Indians prepare bundles of rushes, which they place vertically in the lake, at some distance from the shore. In about a fortnight, every rush in these bundles is completely covered with eggs; the bundles are then drawn out and dried in the sun, upon a cloth, for not more than an hour, when the eggs are easily detached. The bundles of rushes are then placed in the water again for another crop.—*Comptes Rendus,* Nov. 23, 1857, p. 865.

On a new Lagomys *and a new* Mustela *inhabiting the North Region of Sikhim and the proximate parts of Tibet.* By B. H. Hodgson, Esq., B.C.S.

Mustela Témon, nob. *Témon of the Tibetans.*

This species is $9\frac{1}{2}$ inches long from snout to vent, and the tail is $6\frac{1}{2}$ more. Its fur is short, soft and straight, being scarcely longer on the tail than on the body. The colour is, above and laterally, with the entire tail, brunnescent fawn; below, entirely pale pure yellow, save the head and margin of the upper lip, which, as well as the limbs, are canescent; the last, however, with more or less of a brownish tint to the front or externally. The tail is $\frac{2}{3}$rds the length of the animal. The fur is $\frac{3}{8}$ths of an inch long and very fine. The dimensions are as follows:—

	inches.
Snout to vent	$9\frac{1}{2}$
Head	2
Tail and hair	$6\frac{1}{2}$
Tail, less hair	$5\frac{1}{2}$
Ears	$0\frac{3}{4}$
Palma and nails	$1\frac{1}{8}$
Planta and nails	$1\frac{1}{2}$

Lagomys Curzoniæ, nob. *Abra of the Tibetans.*

My specimens were procured in the district of Chumbi. They are three in number, and in fine preservation and high state of fur. They are quite alike in size and colour, and demonstrably mature from the state of the teeth. They measure $7\frac{1}{2}$ inches from snout to vent, and are of a murine fulvous colour, palling and canescent below and on the extremities. The fur is exceedingly soft, full, and smooth, of two sorts, or woolly and hairy, but both of silken delicacy; internally dark slaty blue, externally fawn colour, more or less obscured and darkened by the internal colour. The dimensions are as follows:—

	inches.
Snout to vent	$7\frac{1}{2}$
Head	$1\frac{3}{4}$
Ears	$0\frac{3}{4}$
Snout to eye	$0\frac{7}{8}$
Eye to ear	1
Palma and nails	$1\frac{1}{8}$
Planta and nails	$1\frac{1}{4}$

This beautiful little animal is appropriately dedicated to the Hon. Mrs. Curzon.—*Journal of the Asiatic Society of Bengal,* No. 3, 1857.

Darjiling, April, 1857.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 2. FEBRUARY 1858.

IX.—*On the Natural History of the Cingalese Pearl Oyster and on the Production of Pearls. Derived from* Dr. Kelaart's "Introductory Report on the Natural History of the Pearl Oyster of Ceylon," *and from* "Die echten Perlen, ein Beitrag zur .... Geschichte derselben," by Dr. Karl Möbius, Hamburgh, 1857. By W. S. Dallas, F.L.S.

Without following Dr. Möbius through his long and interesting account of the Pearl-fisheries and the commerce in pearls from the earliest periods to the present time, we may take the fact that the annual importation of pearls into France and England alone averages in value between £40,000 and £50,000 as a convincing proof of the importance of the traffic in these articles of luxury. Moreover, when we consider that one of the principal existing stations for this fishery is upon the coast of the British Island of Ceylon, and that, in accordance with immemorial custom, the Government of the island has a *direct* interest in the prosperity of the fishery, which is still carried on in the same fashion as that by which the celebrated pearl of Cleopatra was obtained from the deep,—it will readily be admitted that it is a matter of no small importance to the Government of Ceylon to ascertain whether the pearl-oyster banks may not be rendered more productive by a better system of management. Is it not possible that these valuable Mollusks may be treated somewhat in the same way as our so-called 'Native' Oysters, so as not only to protect them from injurious influences, but also to enable them to be procured by a more economical process than that primitive one of human divers, which still prevails wherever the pearl-fishery exists? To settle this important point, the Governor of Ceylon commissioned Dr. Kelaart, in March last, to investigate

the natural history of the Pearl Oyster, and we have now before us that gentleman's first report upon the subject. His investigations were carried on by keeping the animals partly in tubs and other vessels, partly in perforated wooden boxes and old canoes sunk at various depths in the sea, and partly in aquaria with glass fronts, to the usefulness of which in facilitating observations Dr. Kelaart bears strong testimony; and he also, apparently unexpectedly, obtained great "facilities of observation amongst the small beds of oysters found in the inner harbour of Trincomalee. They are found of all ages and sizes, at various depths and on different kinds of banks; so that," adds Dr. Kelaart, "no naturalist has perhaps ever had the same opportunities of observing the habits of the Pearly mollusk as I have at present."

The Ceylonese Pearl Oyster is the *Mytilus margaritiferus*, Linn., the *Meleagrina margaritifera* of Lamarck, which appears to be common to all the shores of the Indian and Pacific Oceans, from the Red Sea and the east coast of Africa in the west, to California, Panama and Chili in the east. The Ceylonese shells belong to that variety of the species described by Leach under the name of *Avicula radiata*; indeed, Templeton seems inclined to regard it as a distinct species. On the other side of the Isthmus of Panama, in the Gulf of Mexico, and wherever Pearl Oysters occur on the west coast of America, the species appears to be the *Avicula squamulosa*, Lamk. The anatomy of the animal is described by Dr. Kelaart as follows:—

"The free border of the mantle lining each valve dips downwards to meet a similar veil on the opposite side, thus forming a kind of double-fringed veil. The one set of tentacular fringe, in immediate contact with the shell, is composed of hairy tentacles, looking horizontally forwards; the other, about $\frac{3}{8}$ths of an inch apart from the former, and lining the edge of the mantle from side to side, looks downwards, and dovetails with the tentacles of the opposite flap of the mantle. These tentacles consist of a series of long and short flat filaments—the long ones having lateral filamentous projections. The tentacles are exceedingly sensitive; and one would almost give them the power of seeing; for not only the touch of a feather, but the approach of one, when the animal is lively and in good health, makes them draw forwards, and perfectly shut out the intruder. As these molluscs have no organ of sight, I have no doubt that the delicate nerves which are distributed through the mantle and its tentacular processes, possess in some degree the sense answering to vision in other animals, as well as of touch; for an oyster will be observed rapidly to close its valves on the approach to the aquarium of a lighted candle, or even the approach

of a hand, or the shadow of a person, near the glass sides of a vessel in which it is confined. I should not in a popular Report advert to this physiological subject, but that the senses of the oyster have a great deal to do with its habits, not only in the aquarium, but also in its native bed. Were it not for these delicate fringes surrounding the mantle, the softer parts of the oyster would easily become the food of a host of carnivorous creatures abounding in the sea; and many more pearls would drop out of the shell than do now with such sentinels at the entrance of its external rim. The mantle is the only organ the animal has for the formation of the shell, the increase of the lateral dimensions of which, and the formation of the pearly nacre, and pearls, depend upon the condition of this important investment. If it is injured, the pearly matter is not secreted in such abundance over the shell, or if, by some cause, it becomes retracted, the shell does not grow rapidly, and the mother-of-pearl lining is jagged at the edge, and is not of the usual brilliant colour. However, its temporary retraction facilitates the ingress of sand and other irritating particles, which doubtless become the nuclei of many a pearl, as will be hereafter observed. The fore part of the mantle is coloured and rayed like the shell. The colouring matter is secreted by glands found in these parts. This glandular secretion serves the purpose of increasing the lateral and longitudinal dimensions of the shell. It is after this is deposited, that the pearly secretion (nacre) is applied to the inner wall of the shell, which, concreting or solidifying, increases its thickness. The pearly fluid is secreted by nearly the whole external surface of the mantle. It will be thus clearly understood that when a grain of sand or the larva of an insect is introduced between the mantle and shell, it will become covered over with the pearly secretion; which, always going on, is augmented at that part where the foreign matter lies. This phænomenon I have detected, with the aid of the microscope, in its very earliest stage.

"About 1¼ inch from the rim of the shell, is seen a pair of gills, like four segments of a circle, or semilunar combs, stretching transversely from one side to the other, the convexity looking forwards. There is a vacant space between the concave surface of the gills and the body of the oyster. The adductor muscle, called 'gristle,' is now seen, covered over with a delicate membrane. This muscle is attached to the inner surface of both the shells. On one side (the left, when the oyster is placed with the hinge next the observer) is seen a short, conical, tubular, sharp-pointed prolongation; this is the terminal end of the intestines: it looks like a sharp-pointed claw. The intestine is short; leaving the stomach, it winds round the adductor muscle,

and terminates, as I have just remarked, on the side opposite to where the mouth is placed. There is always an unclosed space between the edges of the mantle, when the tentacles are brought together, admitting of the free passage of excrementitious matter; and it was through the same opening between the mantle, that I observed, on one occasion, the ova escape, in a cloudy stream which continued to pass into the water for nearly fifteen minutes. I failed to detect the immediate part of the animal through which the ova found their exit; and I have not been able to detect a regular oviduct. The ovaria, when distended with ova, cover nearly the whole of the stomach, heart and liver, and project even on the conical cæcal process of the stomach, and also on the base of the foot. The stomach is very small, placed in the centre of the liver; the œsophagus is very narrow, scarcely admitting a moderate-sized probe; it is about 3 lines long. The mouth, situated near the hinge, behind the foot and byssus, is a horizontal slit, of about 3 lines in length, in the duplicature of the lower pair of labial palps. These palps are large, broad, truncated anteriorly, and rounded on the sides; the inner surface plaited, or rather grooved. The sense of feeling or touch is, no doubt, by this rugose structure, greatly increased. The palps serve the animal as organs of touch, if not of taste; they also serve to collect food, and give the animal the power of rejecting indigestible particles of matter, or such substances as might prove injurious."

The food of the Pearl Oyster, according to Dr. Kelaart, consists of minute Algæ, Infusoria, and Foraminifera. *Diatomaceæ* and other microscopic organisms are found growing abundantly on the outer surface of the shell; "so that the oyster may be said to carry on its back the food upon which it lives."

The Pearl Oyster of Ceylon is of small size, the shells usually measuring only 2½–3 inches in their largest diameter; but it nevertheless takes six or seven years in reaching maturity. Like our Common Oyster, it appears to have the sexes distinct; at least, although the majority of the specimens of all ages are found to contain ova, a few are met with bearing "spermatozoa or seminal fluid, in organs similar to those which, in a larger number of individuals, contain ova." Even the native divers are of opinion that there are *male and female* Pearl Oysters; and Dr. Kelaart justly states that "the important part which the male oyster must play in the formation of banks of oysters is self-evident, if it can be clearly established that the ova absolutely require the vivifying influence of a male fluid," or, rather, that this fluid is always secreted in the sexual organs of male individuals. At the same time he observes, that he has not seen more than three or four individuals with this milky

fluid in a hundred oysters; and if this should prove to be the normal proportion between the sexes, the importance of recognizing and preserving the males would become still more evident. He adds, that he has not "yet satisfactorily made out any difference in the characters of the shells of the two supposed sexes. The native divers' opinion, quoted by Capt. Steuart and Mr. Lebeck, viz. that the large flat ones are males, and those that are thick, concave, and vaulted, females," is not borne out by his microscopical observations, as he found well-formed ova in oysters which were broad and flat.

With regard to the fecundation and spawning of the Pearl Oyster, Dr. Kelaart states that from March to June every oyster that he opened, whether young or old, except the few which contained the milky seminal fluid, had ova in the ovaria, so that the Pearl Oyster, like the Common Oyster, is in spawn almost from its birth. From July to September, when the present investigations were brought to a close, the oysters examined did not all contain ova; in some the ovaries were only half full, in others nearly empty. "It will be interesting," as the author observes, "to proceed with these monthly examinations, and to ascertain whether the oyster is only in spawn at certain periods of the year; and, if possible, to determine whether it spawns more than once in twelve months." The ova are pear-shaped, measuring $\frac{3}{1000}$ of an inch in diameter at their widest part, and $\frac{6}{1000}$ of an inch in length. The number of eggs contained in the ovaria of an oyster of five or six years of age are calculated at not less than twelve millions, so that the fecundity of the animal must be exceedingly great.

The foot with the byssus is described by Dr. Kelaart as follows:—

"This important member, which has so many useful services to perform in acephalous mollusks, requires a more than ordinary consideration. It is that long, brown, leech-like member, which is seen when the animal is at rest, coiled up in a corner on the right side, above the byssus, which, when protruding out of the shell, and moving about, gives one the popular idea of a tongue. It is of a dark brown colour above, and whitish beneath; in middle age it is speckled. It is composed of longitudinal and transverse muscular fibres, the latter interlacing between the former, which proceed in two columnar masses from each side of the adductor muscle; between the bundles of fibres are placed the abdominal viscera. From its base is sent off, posteriorly, a glistening white fibrous band; this is attached to the duplicature of the mantle, near the angle of the valves. Thus the foot is seen to be admirably adapted for locomotive powers; and also serves, by its connexion with the adductor muscle, to lengthen

or shorten the cable or byssus. The foot, in a full-sized oyster, is about two and a half inches long when extended; at rest, it is not more than one and a half inch in length. It is broad at the base, tapering to a conical point; the upper surface is rounded and smooth, the lower flattened and grooved. The groove extending from the base, terminates at the point in an oval cup-like fosset. This groove is lined by a secreting membrane, and is an exact mould for the formation of the byssus, at the will of the animal. When it finds a necessity for making one, the foot is protruded out of the shell, and with the tip it seeks out a spot where it can rest the terminal disc of the groove. If not satisfied with the substance or position of the stone or any other matter on which it rests, it removes to another more suitable spot; for a few minutes (say five or six, if the animal is strong) it rests, and is then retracted within the shell, leaving behind a strong fibre with an oval disc, of the form of the groove in the foot. This whitish fibre is attached to the base of the foot at one end, and to the rock, or to the shell of another oyster, at the other. In a day or two, this fibre becomes of a bronzed greenish colour, and looks like hair, with a broad flattened oval root attached to the rock. This process is again and again repeated, at intervals of a few minutes, till a sufficiently strong cable is formed. In a large oyster, removed from the sea, upwards of fifty such fibres form a thick strong cable or byssus, which is attached to the base of the foot by a bifurcated fleshy root. The animal cannot detach the byssus from the rock to which it is attached, but it has the power of casting it off its own body and leaving it behind (like a ship letting slip her cable and anchor in a storm, and sailing off to sea), in order to make another byssus, either on the same rock, or on any other convenient place.

"I observed all this process in the aquarium, at a very early period of my investigations; and was not surprised to find, that the Pearl Oyster, having nearly the same organs as the Mussel, should form and reform its byssus. But I was agreeably satisfied in learning by these observations, that Captain Steuart, in his valuable and interesting 'Monograph on the Pearl Fisheries of Ceylon,' was incorrect in denying to the Pearl Oyster this faculty. He states, that *'it is not believed that Pearl Oysters have the power to detach themselves, or to remove at their own will.'* I have not only satisfied myself, and many friends who have seen the oysters in the aquaria which I have established, that the Pearl Oyster can detach or unmoor itself, but likewise that it walks away with its foot foremost, and the shell behind; and does not, as Captain Steuart observes, *'move with its hinges in advance.'* This 'shuffling' movement alone attracted Cap-

tain Steuart's attention, but it is an unimportant one; as all bivalves without a byssus have it, and it is independent of the will of the animal, owing to the valves being opened and closed for the purpose of respiration."

"When an Oyster is first put into a vivarium, it sickens, *i. e.*, the mantle becomes retracted, and a collapse is observed;—in a few hours it revives, but, with few exceptions, it is on the third or fourth day that the portion of byssus attached to the foot of the animal is shaken or cast off, and the animal puts out its foot and forms another near the spot where it lies; or walks, by a snail-like motion of its foot, to, or up the side of the glass, to the level of the water, and there fixes itself. Some of the oysters which were thrown into the sea, are now seen growing on the sides of rocks, four and five feet from the bottom."

These observations are conclusive as to the power possessed by the Oyster of reforming its byssus, and the possibility of removing it from the deeper parts of the sea to situations where the fishery may be carried on conveniently; and this appears to have been proposed by Dr. Wright, in a Report prepared about the year 1803, which, however, seems to have been misunderstood. It appears, in fact, from Dr. Kelaart's observations, not only that the Pearl Oyster can reproduce its byssus when it has been torn from its previous resting-place, but that it can even detach itself voluntarily from its moorings and attach itself in another place, and this not once only, but several times, as he has noticed "that some oysters will go through this process a dozen times in less than a month." This power of forming a new byssus is possessed even by the large specimens, although in a less degree than in younger individuals; the latter also possess more locomotive power than those of greater age, and appear to employ it in gratifying their strongly gregarious instincts; for Dr. Kelaart tells us, that when several young oysters are placed in various parts of an aquarium, they will, sooner or later, be found attached to each other; and he adds, that "the older ones have also this desire; but their heavy shells impede their motions, and they are contented to remain apart from their fellows." The formation of a new byssus is sometimes caused also by crabs, shrimps, and other marine animals nibbling through the old one. Dr. Kelaart also states, "that the Pearl Oyster will move about in search of food, if the locality in which it is originally placed is not rich in its natural supplies," and that it will quit its original situation if the water is much agitated or rendered impure by mud, or the decomposition of organic matter, or unfitted for its habitation by a great influx of fresh water. Nevertheless, the mollusk appears to be exceedingly tenacious of life; for it will "live in brackish water,

and in places so shallow that it must be exposed for three or four hours daily to the sun and other atmospheric influences."

Taking all these circumstances into account, there seems to be every foundation for the hope expressed by our author, that the Pearl Oysters may be successfully transferred from their native beds, and made to colonize other parts of the sea. His experiments, indeed, appear to be conclusive upon this point. He says:—

"I have successfully established a colony of Pearl Oysters near Fort Frederick, in the open sea, at various depths; and have also oysters which have been living for several months in wooden boxes, finger-glasses, glass globes, chatties, and large canoes, sunk in the sea. Some were thrown into the sea, after being removed from the inner harbour and kept in my house in chatties and tubs for two and three days. The byssus of most of them had been broken and torn from the rock. These they have cast off, and are now living attached to each other, and to pieces of coral, and to rocks, exposed to all the influences of the sea."

Of the general habits of the Pearl Oyster Dr. Kelaart speaks as follows:—

"The whole occupation of the Oyster, when fixed to a spot, appears to be, keeping its valves open and admitting food to its mouth. For several hours the valves remain open, they then close for a few minutes, or for an hour or two, then open again. At night, the valves remain generally open till towards daylight, when they close, and remain so till the sun shines brightly over the horizon. It is during the early part of the night, or soon after sunset, that they exercise, *when required*, their locomotive powers. I have watched the oysters in aquaria for nearly a whole night; and they appear to be then active in moving and attaching themselves to new localities. During the day I have only seen on one occasion an oyster form a new byssus. This nocturnal habit is, doubtless, an instinctive precaution; for should oysters move during the day, they are more likely to become the food of fishes and other animals which prey upon them. Their movements are instinctive, and guided by the sense of touch. Darkness suits them better than daylight, of the difference of which they are very sensitive."

The Tamblegam Pearl Oyster.

It is well known that, besides the true Pearl Oyster, many other species of Mollusca produce perfect pearls, some of which possess considerable lustre. Amongst these is the Common Oyster (*Ostrea edulis*, L.), which sometimes contains good pearls, as in

the case referred to by Möbius of a worthy Hamburgher, whose tongue detected the presence, in an oyster which he was on the point of swallowing, of a pearl, for which a jeweller paid him upwards of three pounds (22 dollars). The common *Anodonta cygnea*, L., of our fresh waters, also occasionally contains small pearls; and the European Pearl Mussel (*Unio margaritifer*, L.) is the object of considerable fisheries in some parts of Germany, as it was formerly in our own country. Of other known pearl-bearing Mollusca, Dr. Möbius mentions that the *Pinna nobilis*, L., produces a brown pearl; *Mytilus edulis*, L., a pale-blue one; *Spondylus gæderopus*, L., greenish and pale rose-coloured pearls; *Arca Noæ*, L., a violet, and *Anomia Cepa*, L., a purple pearl. Nearly allied to the latter is the species referred to by Dr. Kelaart as the Tamblegam Pearl Oyster (the *Placuna placenta*, L.), which, like the *Anomia*, belongs to the great family of the *Ostreidæ*. It is found in the salt-water lake of Tamblegam, which is separated by a narrow neck of land from the great harbour of Trincomalee, and although the pearls produced by it (which are of a lead-colour according to Möbius), are not more than one-third of the value of those obtained from the true Pearl Oyster; still, as the number of pearls procured from them per thousand is three times as great as that obtained from the *Meleagrina*, and the shells, according to Dr. Kelaart, are worth *at least* ten shillings per thousand, whilst those of the true Pearl Oyster of Ceylon are of little or no value in consequence of their small size, there seems to be every reason for believing that, with proper management, this pearl-fishery of Tamblegam would constitute an important source of revenue to the Government of Ceylon. This, however, as we shall see, is at present by no means the case.

The Tamblegam Oyster (*Placuna placenta*) is called the 'Vitre Chinoise' by some French writers, and the 'Window Oyster' by English travellers in China, from the circumstance that its semi-transparent shells are used by the Chinese instead of glass in windows. "When full grown, the valves measure, at their broadest transverse diameter, from 6 to 7 inches, and their longest longitudinal diameter is about the same; some, half an inch more." They appear to arrive at maturity in about three years, and to thrive best in brackish water, although they are destroyed by a great influx of fresh water. As in the true Pearl Oyster, the young have ova in their ovaries. The Tamblegam Oyster, "having no byssus, is not attached to any hard substance, nor is it cemented, like some of the edible oysters, by the hinge, or by one of the valves, to any object, but lies either flat on the mud, or is fixed loosely in a semi-vertical position, with the wedge-shaped hinge buried in the mud." From this circumstance, coupled with the exceedingly flattened form of

the shells, pearls are very liable to drop out when the animal reaches its full growth; and Dr. Kelaart therefore recommends, "as the best periods for fishing, the time when the animal has closed its supposed two years' age, or when the shell measures from 5½ to 6 inches in transverse diameter."

The fishery in the Tamblegam Lake, as elsewhere, is carried on by divers, and from Dr. Kelaart's statements great injury appears to have been done to the banks, by the granting of a three-years' lease to native renters, without any proper restriction as to the size of the oysters to be fished. One bank, called the Natcha Cooda, is already ruined, unless the Government takes steps to restock it with young oysters; and Dr. Kelaart considers that "there is no prospect of even an average good fishery before the middle of 1859." He says:—

"I watched the number of oysters fished during the two days I was lately at Tamblegam (Keenear), and have to report, that there could not have been less than 30,000 on each day. More than two-thirds of this number were young, and had better have been left in the lake for another year or more. The renter is evidently making the most of the few months he has yet liberty to fish, or *rather ruin the bank*. The Tamblegam Wanniah, and all the divers whom I questioned on the subject, stated, that in the early part of the present year more than 50,000 oysters were fished daily. It is therefore impossible to arrive at any other conclusion, than that the former renters misrepresented the state of their finances, from the Pearl-banks, when they got Government to remit some portion of the rent, and had the fishery re-sold for a smaller sum, to another native,—a relative, I am informed, of one of the original renters.

"All oysters are very prolific, and the *Placuna* is not an exception to the rule; for, at the lowest calculation, in three years there must have been fished from this bank, upwards of 18 millions of oysters, supposing that there were *only* 200 fishing days in each year. The renters' share must have been (allowing five shillings for each thousand oysters) nearly £2250, from which, deducting the three years' rent, viz. £901, they must have derived a profit of at least £1250. To this profit must be added another source of gain (a very ingenious one), from the divers' share of oysters. The diver is allowed half the quantity fished, but he is not permitted *to sell* the oysters at the best market, or to the highest bidder. He is obliged to open the oysters when fresh, and sell to the renter all the pearls, at a fixed rate, which the renter takes good care shall be below the market value. Any plan, therefore, which may relieve the diver of this grievance, will, I am sure, be thankfully welcomed by at least 200 individuals, whose chief means of living is by diving for Pearl Oysters."

Taking these facts into consideration, Dr. Kelaart advises the application of various restrictions to the fishery, the nature of which will suggest themselves readily enough to most naturalists, and at the same time recommends the employment of ordinary oyster-dredges for removing the mollusks from the banks; being unattached, they would of course easily be brought up by the dredge. The small oysters brought up might be returned immediately to the bank, or kept to be transferred to some other suitable locality. By this means he thinks the numerous salt-water lakes of the Ceylonese coast, such as those of Calpentyn, Puttam, Batticaloa and Hambantotte, might easily be stocked with this Pearl Oyster, when they would yield a handsome revenue to the Government. To test the feasibility of this proposition our author has already removed about 1200 middle-sized oysters, obtained from the water of the Tamblegam fishery, to *Yard Cove* in Trincomalee Harbour, where the muddy bottom promises to be suitable for breeding them.

Production and Structure of Pearls.

"There are pearls," says Möbius, "which, like the shells in which they were formed, consist of three different systems of layers,—only that these are superposed in a reversed order. In the shell, the nacreous layer forms the *innermost* coat; in the pearl, on the contrary, it constitutes the shining outer coat; so that the pearl, as it were, only represents a reversed pearly shell, and consequently possesses all the chemical and physical properties of the latter, except those for which it is indebted to its round form." Under these circumstances the qualities of the pearl must necessarily depend to a very great extent upon those of the shell in which it is produced; and the analysis of the nacreous layers of different shells shows a sufficient diversity of composition to account for the different qualities of the pearls produced from them. Thus, according to Schlossberger, the nacreous layer of the Common Oyster contains 94·7–98·2 per cent. of carbonate of lime with only 0·8–2·2 per cent. of nitrogenous organic matter; whilst the same layer in the true Pearl Oyster contains, as found by Ulex, only 87·6 per cent. of carbonate of lime, and the amount of organic matter rises to 11·8 per cent., or more than five times the largest quantity found by Schlossberger in the Common Oyster. The latter also contains 0·8–3·1 per cent. of other earthy salts wanting in the Pearl Oyster, which, however, contains 0·6 per cent. of chloride of sodium. It is to this large amount of organic matter that the true pearls are indebted for their hardness, which is considerably greater than that of crystals of carbonate of lime; and the same

cause is doubtless effective in heightening their lustre. The large amount of organic matter contained in them also explains their low specific gravity, which is 2·650–2·686, or 0·1–0·3 less than that of pure calcareous spar or Arragonite.

The *surface* of pearls is not perfectly smooth, but covered with very fine microscopic elevations and depressions. These are more or less irregular in their altitude, but approach most nearly to equality in pearls of the finest water. In pearls which exhibit a certain iridescence, and which, when turned in different directions towards the eye, present even very faint bluish, greenish, and reddish tints, the surface is found to present delicate, irregularly curved furrows, which either run tolerably parallel to each other, or form small, irregular, closed curves. This is due to the mode of growth of the pearl, in which thin layers of nacre of small dimensions have been laid over each other. There is no continuous layer all over the pearl, but a number of small portions, which sometimes overlie the margins of the subjacent layers, and sometimes leave them uncovered*. This structure is seen most distinctly in the pearl shell, where the conditions are rendered more simple by the layers being deposited on a flat or but slightly curved surface. The distance of the furrows from each other is not always the same: sometimes they may be recognized with the simple lens, whilst on other parts they approach within $\frac{1}{3000}$th of an inch of each other. That the iridescence of nacre, or the nacreous colour, as distinguished from pearly lustre, is caused by the interference of the light reflected from these furrows and the intervening edges of the strata, is proved by the circumstance, ascertained by Brewster, that impressions of mother-of-pearl taken in red or black sealing-wax exhibit the same phænomena of colour distinctly. In pearls, in consequence of their spherical form, the different masses of coloured light are so diffused, that they unite to form white light; and this takes place with the greater perfection in proportion as the furrows are lost, and become converted into a surface of fine elevations and depressions.

For their *lustre* pearls are indebted to their being composed of thin layers, which allow light to pass through them, whilst the numerous layers lying one under the other, disperse and reflect the light in such a manner that it returns and mixes with that which is directly thrown back from the outer surface. It is the cooperation of light reflected from the surface with light dispersed and reflected in the interior, that gives rise to lustre; for this reason the knots of window-glass exhibit pearly lustre, and the membranes of pearls deprived of their lime are almost as

* "This discovery of the stratification solves the contradiction between Brewster's and Carpenter's representations of the matter." (Möbius.)

lustrous as solid pearls, except that their whiteness is destroyed. "The two masses of light entering the eye, act upon it from different distances. Now as it adapts itself to the body seen through the transparent layer, it cannot distinctly see the light reflected from the surface, and the consciousness of this infinitely perceptible reflexion produces the phænomenon of lustre" *. The thinner and more transparent the layers of which the pearl consists, the more beautiful is its lustre, and in this respect the sea-pearls excel those of our river-mollusks.

Besides the furrows on the natural or cut surfaces of mother-of-pearl, fine sections or laminæ of cleavage exhibit a second system of *fine dark lines*. These, however, are never so distinct as the superficial furrows, but always appear somewhat cloudy and very finely undulated. In several specimens in the possession of Dr. Möbius they follow the same direction, whilst that of the superficial furrows varies frequently; so that the two systems are sometimes parallel and sometimes intersect each other at all angles. These minute lines also remain at the same distance apart ($\frac{1}{7700}$th of an inch, according to Herschel †). This structure of the nacreous layers is probably of great importance in the dispersion of the light which is reflected by mother-of-pearl.

In pearls these fine dark lines usually run round the globe in the direction of circles passing through its poles. Sometimes, however, they run in very various directions, and in a pearl from *Unio margaritifer* from which Dr. Möbius had dissolved the carbonate of lime by acetic acid, the lines of the different strata of membrane crossed each other at various angles.

In thin sections of pearls a quantity of fine lines run round the central point in the layer of nacre, but these rarely form closed curves, most of them losing themselves again without completing the circuit, and thus showing, like the superficial furrows, that the pearl does not grow by complete spherical coats, but by the superposition of small segments. Sometimes layers occur which run almost all round, and show that they were formed at one time, by their uniformly darker colour. These concentric lines of the nacre are intersected by two systems of extremely fine lines at angles of about 10–15°, whilst the latter intersect each other at angles of about 20–30°. These lines appear to be due to an intimate structure of the nacreous layer, probably to the unequal inclination of its particles towards the cut surface. When a portion of the layers are cut at an acute angle, transitions are seen to take place from the superficial furrows to these lines. It is also probable that the above-

* Dove, Farbenlehre und optische Studien, p. 117.

† Edinburgh Phil. Journ. ii. p. 114, 1820.

described fine dark lines of the nacreous layers take part in their formation, and especially in giving them their finely punctured appearance when cut transversely.

In one section from a sea-pearl of good lustre, the nacreous layers are penetrated almost all round by dark ramifications arranged radially. These have also been found by Carpenter in many shells; as they do not disappear with the carbonate of lime, he regards them as walled (*ausgekleidete*) canals.

The finest pearls usually consist only of nacreous layers surrounding a nucleus. To this their white colour is due, as a large dark nucleus shines through the layers, and renders them dull. The grey tint of the so-called immature pearls is due to *columnar cells,* identical with those of the middle layer of the shells, which extend radially from the nucleus to the nacreous layers. In transverse section these appear as three- or six-sided cells with straight or curved outlines, and they either retain the same diameter throughout, or have their extremities pointed and wedged in between each other. When the lime is removed by acetic acid, they remain as hollow columns, with brownish membranous walls. In the midst of them there often rises a membranous plate, which looks like a cell-nucleus, and which is attached to a delicate membrane situated between the columnar and nacreous layers. The membranous walls of the columnar cells are either transversely striated, or furnished with transverse rows of pores; and in one case the pores and striæ occur together in the same column. Carpenter regards these columns as consisting of flat cells laid one upon the other, and we may suppose that the fusion of these takes place in the same way as in the formation of the vessels of plants. This view has certainly more in its favour than that of Heinrich Meckel*, who supposes that the columnar layer is produced from the nacre in the same way as Réaumur's porcelain from amorphous glass.

In many pearls the inner extremity of the columns rests upon a brownish-yellow mass which encloses the nucleus. It is usually homogeneous, rarely stratified, and possesses all the properties of the epidermis of the shells. This leads us to the consideration of the formation of pearls and its causes, upon which so many theories have been propounded.

According to the ancient Indian notion adopted by Pliny, and after him by many others, the mollusk is incited to the production of pearls by the falling of drops of dew into its gaping valves; and so firmly had this idea taken possession of the human mind, that Columbus, on discovering the coast of Paria, thought he had fallen upon the right place for pearls,—the trees grew with their roots in the sea, and these very roots were

* Mikrogeologie, p. 26, 1856.

covered with oysters, ready to receive any quantity of dew-drops that might fall from the leaves above them. But the oysters unfortunately were of the wrong sort. Ælian's theory was, that pearls were produced by lightning flashing into the open shells; and it was not until many years later that a less poetical race of naturalists adopted more material hypotheses, and attributed to pearls a similar origin to that of the gall-stones, urinary calculi, Bezoar-stones, and other concretions found in the higher animals. According to another view, pearls were the eggs of the mollusks; and Dr. Möbius quotes from Valentini a statement that, in the year 1700, "a Swedish major and a Livonian nobleman saw a shell-fish creep out of a pearl which a fisherman had laid before them on the table." In 1717 Réaumur showed that the structure of pearls was identical with that of the shells producing them, and that those of the *Pinna* of the harbour of Toulon consisted either of nacre, or of a system of columns, according to the place in which they were formed.

Under any circumstances, however, the production of pearls can hardly occur in the natural course of the secretion of the materials of the shells, and they must be regarded as abnormal deposits of this material, the impulse to which must be given by some peculiar cause. Réaumur ascribes the formation of pearls to a morbid effusion of the coagulating shell material, and Dr. Möbius considers that this may sometimes be the case with those pearls which have a crystalline calcareous nucleus. But these appear to be few in number, and it seems now to be a settled point that, at all events in most cases, the formation of pearls is caused by the intrusion of foreign bodies between the mantle of the animal and its shell. By the majority of writers grains of sand are described as the most frequent irritants, and Dr. Kelaart appears to admit their intrusion as one of the causes of pearl formation*; but, on the other hand, Dr. Möbius states, that of 44 sea-pearls (from America and the East Indies) and 15 freshwater pearls, of which he has prepared sections, not one presented a sand-grain as its nucleus. A few, as already stated, contained a "radiately fibrous, crystalline calcareous nucleus," but in the majority the nuclei were of an *organic nature.*

With regard to the origin of these organic nuclei, two theories have been put forward. According to the earliest of these hypotheses, set up by Sir Everard Home in 1826†, the ova of the mollusks form the nuclei of pearls; and in support of this view the author stated that he had found pearls in the ovary, and adduces two letters from C. Sandius, dated in 1673 and 1674, and published in the 'Philosophical Transactions' for the

* See p. 83. † Phil. Trans. 1826, p. 338.

latter year, in which the same opinion is expressed. This theory of Sir Everard Home's was contradicted by Von Baer, in a paper published in Meckel's 'Archiv' as early as 1830; and it appears to be untenable as regards the formation of pearls from abortive ova *in the ovaries,* but a modification of it is brought forward with great appearance of probability by Dr. Kelaart, who says, "that the ova which escape through the distended coats of an overgrown ovarium, and are imbedded in the interstices of the mantle, become nuclei of pearls formed in this situation." In support of this view he states that he has "repeatedly examined seed, or young pearls, in process of formation; and with a magnifying power of $\frac{1}{5}$-inch lens, was able to see distinctly the outlines of two or three ova through the first or superficial layer of nacre, surrounded by groups of ova. It can be readily understood how an overcharged ovarium will, by some accident or spontaneous evolution, have its coats ruptured, allowing the ova to escape and become inserted in the contiguous attenuated parts of the mantle. As pearls are more usually found imbedded in the mantle near the hinge, the most likely place where the ovarium is liable to rupture, I consider this very conclusive of the new theory I have here proposed*."

(Dr. Kelaart also thinks it possible that the siliceous skeletons of the Diatomaceæ, which constitute a great part of the food of the Pearl Oyster, may sometimes, by escaping through the coats of the stomach or otherwise, get into the interstices of the mantle, and there give rise to the production of pearls. He adduces no positive observations in confirmation of this opinion, except that he once, in examining "seedling" pearls, found a *Navicula* amongst the [escaped ?] ova.)

The second modern theory above alluded to is founded upon the observation of the fresh-water pearl-bearing Mollusks (*Anodontæ* and *Uniones*), and attributes the formation of pearls to the intrusion of parasites into the mantle. Filippi† found in some ponds in the park of Racconigi, near Turin, individuals of the common fresh-water Mussel (*Anodonta cygnea*), the mantles of which contained sacs with larvæ of *Distoma duplicatum,* Von Baer, and at the same time saw "a corresponding quantity

* It would appear, however, that Dr. Kelaart thinks it possible that an over-distended ovarium is one of the causes of pearls being discharged from the oyster and lost. He adds: "If this be really the case, it will easily account for the singular fact, that a sample of oysters, fished in the month of October, will yield a larger proportion of pearls than a batch of oysters fished from the same bank in the months of April and May of the following year."

† *Sull' Origine delle Perle,* translated with notes by Dr. Küchenmeister, Müller's Archiv, 1856, p. 251; and *Encore un mot sur la formation des perles,* Müller's Archiv, 1856, p. 490.

of pearly asperities, of various forms and development, passing through all possible degrees to real, shining, nearly spherical pearls, scattered over the adjacent surface of the shell." On carefully removing the pearly concretions which appeared to be youngest, and examining them with the microscope, he always detected in them the remains of *Distomata* (*Cercariæ*), which had served as the nucleus for the calcareous matter. Even in free pearls he found an organic nucleus (consisting of portions of *Echinostomum* and *Limnochares Anodontæ*), although he never found any animal that could be determined with perfect certainty. From these observations Filippi concludes that the production of pearls is intimately connected with the presence of parasites, and that the want of the latter may be the cause of the non-formation of pearls in some localities. He denies that pearls are the result of disease, and that their nuclei are ever formed by grains of sand.

Küchenmeister*, following up the ideas of Filippi, and admitting that pearls may be produced by the intrusion of *Distoma*-larvæ and other Entozoa into the mantle, maintains that the principal impulse to the formation of pearls, at all events in the Saxon river Elster, is given by the water-mite *Limnochares Anodontæ*. The eggs of this mite are deposited in the fresh-water mussels, and enveloped by the latter in cysts, from which, however, the six-legged young can usually escape with ease. After swimming about for some time, and attaining their full growth as larvæ, these hexapod mites return into the mollusk, and become again enclosed in a capsule, within which they change their skin and acquire their perfect form. Thus the natural habits of this mite give rise to the formation of numerous spherical cysts, which may remain in the mantle of the mollusk even after the escape of their inmates, and thus furnish the most favourable conditions for the production of rounded pearls. The mites prefer still water, and it is in situations where this condition is fulfilled that the greatest number of pearls are found.

Küchenmeister's observations induced Von Hessling to investigate this interesting subject in the Bavarian waters, and the results of his researches were published in the *Gelehrten Anzeigen* of Munich (1856). In adherent pearly asperities of the inner surface of the shells of fresh-water mussels he found "partly true sand-grains, or minute particles of fine mud, in which the animals live; partly remains of Algæ with distinctly recognizable conjugations, the individual cellular segments of which are still incrusted; partly eggs in the most various stages of development and decomposition; and partly parasitic animals in the most various stages of development." He only found one *Di-*

* Müller's Archiv, 1856, p. 269.

stoma-nucleus in many hundred small free pearls from the fresh-water mussels, and in "about 40,000 specimens of *Unio margaritifer*, opened partly by Von Hessling and partly by the fishermen, no trace of a parasite or of an egg could be found." No traces of eggs or parasites were detected in hundreds of oriental, Scotch, and Bavarian pearls, which he opened with chisel and saw, and treated with organic and inorganic acids.

Dr. Möbius, however, has arrived at a directly opposite result, by following a rather more cautious method of investigation, and grinding down the pearls with a fine file and stone. His results are therefore far more to be depended upon than those of Von Hessling, who seems to have carried on his researches in rather too wholesale a manner. In eight pearls from the west coast of America he found remains of Entozoa forming the nucleus, and one of those figured in his plate is evidently a Trematode larva. In other curious specimens the nucleus is covered with layers of epidermis, which appear to have been drawn asunder by the movements of the living nucleus. As a general rule, the organic nucleus seems to shrink more or less after its enclosure, and the space thus left is usually filled up in part by crystalline fibres, probably consisting of carbonate of lime infiltrated through the first layers. The pearls already referred to as containing a nucleus of crystalline carbonate of lime are also probably caused originally by the access of young parasites, which, retaining their vitality, subsequently break through the first layers of the pearl, and thus leave a hollow space in its centre. The great weight of evidence, therefore, is in favour of the organic origin of the nuclei of pearls, partly from the eggs and encysted young of parasitic animals, and partly, according to Kelaart, from the escape of the eggs into the interstices of the mantle, on the accidental rupture of an overcharged ovary. Dr. Kelaart and Von Hessling also admit the intrusion from without of foreign inorganic matters as one of the causes of pearl-formation; and the former states that the oysters, when removed into an aquarium, retract their mantle considerably, and retain it in this condition even for some days,—a condition which would be very favourable to the access of extraneous matters to the interstices between the mantle and the shell. It is quite possible that a similar condition may prevail amongst the Pearl Oysters residing in the open sea, for Dr. Kelaart says, "Most of the oysters in which I have found pearls had external marks of having been retarded in their lateral growth, and displaced in early life from their fixed position on a bank. I am inclined to believe that oysters which have abundance of food, and are not disturbed, remain fixed for the last two or three years of their growth to one spot. These are less likely to have a large pro-

portion of pearl-bearing individuals among them. This, of course, requires more extensive practical observation, either on the beds in the harbour of Trincomalie, or on the pearl-banks of Arripo."

Under any circumstances, this retraction and extrusion of the mantle must be of considerable importance in determining the internal structure of the pearls; for as the different layers of the shell (epidermis, columnar layer, and nacre) are secreted by different parts of the surface of the mantle, the pearls which contain more than one of these substances must have been in contact successively with the corresponding regions of the mantle. Thus if a pearl be originally formed at the edge of the mantle (which will be the case when dead extraneous matters get within the shell, whilst the mantle is retracted as above described), the nucleus will be immediately surrounded by a layer of epidermis; and if it be subsequently passed *inwards* (by the extrusion of the mantle or otherwise) through the columnar region to that which secretes the nacreous layer, it will exhibit the three layers in the same order as in the shell. The finest pearls are those formed entirely in the nacre-secreting portion of the mantle; but if those originally produced in this situation be passed *outwards* (by the retraction of the mantle or otherwise), they will acquire a columnar, and even an epidermic, layer; and by passing inwards again, these may be in their turn coated with nacre. Instances of the structures thus produced appear not to be uncommon, and several of them are described and figured by Dr. Möbius. Pearls found imbedded in the tissues of the body at a distance from the mantle, are probably carried to their resting-place by the circulation.

Ever since the admission of the fact that the formation of pearls is caused by the intrusion of foreign bodies between the mantle of the mollusks and their shell, attempts have been made to produce similar effects by artificial means. In 1761 Linnæus announced to the King and Diet of Sweden that he could compel mollusks to produce pearls, at the same time offering to publish his method for the benefit of the State. He seems, however, to have thought better of the matter, and sold his secret for 500 ducats to one Bagge, a merchant of Gothenburg, whose heirs offered it for sale again in 1780. Beckmann, who narrates this, says: "Linné once showed me in his collection a tray of pearls, and said, 'Hos unionis confeci artificio meo; sunt tantum quinque annorum, et tamen tam magni.'" Beckmann adds,—"I believe that Linné had described his art as early as 1746 in one of his works, before he had the idea of making use of it as a mystery. I refer to a line in the sixth edition of the 'Systema Naturæ,' at p. 195, which runs,—'Margarita, testæ

excrescentia latere interiore, dum exterius latus perforatur.'* I once told him that I had discovered his secret in his own writings; he seemed to be embarrassed, made no inquiry as to the passage to which I referred, and broke off the conversation." There is no doubt that attached half-pearls may be produced, when the shell is bored through by a worm, or artificially. These hemispherical pearls are often of large size; Dr. Möbius describes three of nearly half an inch in diameter.

Imperfect pearls are usually produced artifically by inserting foreign substances between the mantle and the shell. The Chinese appear to be the principal operators in this way. According to Grill they insert a string of 5 or 6 spherules of mother-of-pearl into Mussels in a lake near Canton, by which they are covered with a nacreous layer in the course of a year. These pearls are used for embroidery, in which their defects may be concealed. The Chinese also produce hemispherical pearls upon the inner surface of the shells of *Barbata plicata* (*Dipsas plicatus*, Leach), by inserting mother-of-pearl forms between the shell and mantle, and specimens of this shell are not uncommon, bearing numerous attached pearly figures of Chinese deities, formed upon metal moulds in the same situation. Dr. Gray also says that the Chinese produce nearly globular pearls in this mollusk, around silver wire.

Dr. Kelaart states that he has "doctored" some Pearl Oysters "according to the plan adopted by the Chinese, in the case of the large fresh-water Mussel," but does not describe the particular process employed by him. At the end of the copy of his Report which he has had the kindness to forward to us, he has, however, appended a manuscript note, dated the 7th December, 1857, in the following words:—"Since writing the above, I have established the fact, that good pearls can be made by the oysters which are treated as the Chinese treat the fresh-water Mussel. If the Ceylon Government will not establish artificial Pearl-banks, other Governments may try the experiment, and the Arripo bank be in time valueless."

X.—*On the Structure and Affinities of* Myricaceæ, Plataneæ, Altingiaceæ *and* Chloranthaceæ. By B. Clarke, Esq., F.L.S. &c.

[With a Plate.]

Myricaceæ.

The ovary of this family having engaged the attention of some most accurate observers, by whom it is regarded as simple, the following remarks on its structure may prove interesting, especially as the stigmas, which are ordinarily two, are occasionally

* This passage is suppressed in the tenth edition.

increased to three, and also more rarely reduced to one, which requires some explanation before the ovary should be understood as consisting of a single carpel.

At the time of flowering, the ovary presents no appearances which would lead to a satisfactory knowledge of its structure, and in the fruit the characters become too much obscured to be relied on; but the examination of some very young fruits produced by *Myrica quercifolia* in the Botanic Gardens at Kew has supplied this deficiency,—transverse sections of them indicating the presence of two carpels united by their margins, the stigmas also being two (Pl. VI. figs. 1, 2, 3 & 4), which are occasionally increased to three, the stigmas then being three (figs. 5, 6 & 7). The fact that in the ovary of the latter the dorsal suture is equally marked in all three carpels, makes it impracticable to account for such appearances by any other explanation; and as far as my observations have gone, it has proved to be an invariable rule, that when the ovule is single and erect from the base, without any inclination to either side, as in *Myrica* (the stigmas being two or more), the ovary consists of carpels united by their margins, which are the same in number as the stigmas, any accidental inequality of them being the consequence of inequality of the carpels.

In the structure of the ovary, Myricaceæ* approach most nearly to Juglandeæ, the inner circle of the tissues composing the ovary of *M. quercifolia* corresponding with the endocarp of the fruit of *Juglans regia* and *nigra*; the tendency also to dehiscence, shown by angles in the cavity and by a line extending to the dorsum of each carpel (Pl. VI. figs. 2, 3 & 4), being, as in *J. regia*, through the dorsal sutures.

With the Cupuliferæ they agree in the partial separation of the lobes of the anther, especially with *Carpinus*, which, as in *Myrica*, is owing to the division of the connective; and they may also be compared to Abietinæ in the variable number of the stamens, and in their filaments, when numerous, becoming monadelphous at the base. And this approach between the stamens appears so well marked in *Myrica* and *Pinus*, that, next to the affinities between *Casuarina* and *Ephedra*, it may perhaps be regarded as the most obvious connecting link between Gymnosperms and the Amental families; they are in both cases, when numerous, attached to a pedicel, which, in *Pinus*, has been described as composed of monadelphous filaments, but should perhaps rather be regarded as an elongated torus; in both cases, also, their number is irregular,—so much so in *Myrica*, that in one species I have seen them vary from eight to thirty in the

* In *Comptonia* the ovary has the same structure as in *Myrica*.

same catkin; and in one instance nearly forty were all attached to one pedicel-like torus, as though the filaments had become monadelphous; when numerous, some of them were very imperfect, but the greater part of them had the usual double appearance from their deeply divided connective. It is not intended to allude to each cell as constituting one stamen, however distinct they may be; and even in *Comptonia*, which has been described as having six stamens united in pairs, I believe there can be no doubt that there are only three, the connective being rather more deeply divided than in *Myrica*, but each lobe being strictly one-celled, as in that genus*.

But in other parts of their structure Myricaceæ so nearly agree with Urticaceæ and Cannabineæ as to form a connecting link between the Amental and Urtical families, approaching the Urticaceæ in their erect ovule and occasionally succulent calyx, there being also in Urticaceæ a tendency to unite the carpels, when two are present, by their margins, as may be seen in the barren ovaries of *Dorstenia*; and showing some degree of affinity with Cannabineæ in the calyx being either free, as it is in *Humulus*, or partially adherent, like that of *Cannabis* (Pl. VI. fig. 8)†, and in the inflorescence being frequently covered with resinous glands having a cellular appearance like those of *Humulus*.

Plataneæ.

This is also one of the Amental families, the ovary of which is understood as consisting of a single carpel, which has doubtless occasioned the structure of the flower to be overlooked, so

* The anther of *Myrica* has been described as either two- or four-celled; but the four-celled anther I should suppose must refer to a deep furrow at the line of dehiscence, which makes the half-anther appear two-celled.

† That the same membranous cup which is present in the fruit of *Humulus*, loosely surrounding it, exists also in *Cannabis*, but adherent, is shown by the fruit of a variety of Hemp formerly in cultivation in the Botanic Gardens of Chelsea under the name of *Cannabis indica*, in which the upper margin of this membranous cup or calyx is frequently free, forming a shallow, semitransparent ring, as occasionally happens in the fruits of Cupuliferæ, where it is not usually developed, as in the common Nut. In an early stage of the flower it is discernible in the common Hemp (fig. 8), and it may sometimes be easily separated as an entire, colourless, semitransparent, membranous cup, agreeing with that of *Humulus* in being higher on the posterior side,—a character which occurs also in Urticaceæ. In some few flowers it may be found loose, being nearly detached, and in a somewhat monstrous flower with three stigmas this calyx was free and of a greenish colour, having two or three green ribs, the bractlet enclosing it as usual. In this view of the structure of Cannabineæ, the sepal or perigone as usually understood becomes a bractlet, of which there is then one enclosing each flower, and which in *Humulus* forms the large, permanent, scale-like envelope of the fruit.

that the floral envelopes appear hitherto not to have attracted attention (Pl. VI. fig. 11). The male flower (figs. 9 & 13) differs from those of the families with which Plataneæ have been associated as remarkably as the female, so much so as to compel us to look for other relations with which to compare them. The following character is selected from observations which have been repeated at long intervals*:—

Trees with alternate leaves; stipules scarious, or leafy and auriculate. Flowers unisexual, collected in dense capitula. Male flowers sessile, or elevated on very short pedicels, either quite distinct from each other, or two together so as to form a pair with difficulty separated. Bracteæ consisting of from 3 to 5 membranous, oval or obtuse, or truncate scales, fringed with hairs, surrounding the base of the flower, sometimes alternate with the sepals, but having no constant relation to them. Sepals from 3 to 5, but most frequently 3, combined at the base, elongated, with an elevated ridge along the middle, giving them a somewhat plaited appearance, or broad, short and obtuse; 1 or 2 often smaller or deficient, so as to make the flower appear unilateral. Stamens equal in number to the sepals and alternate with them, crested, and having a thickened connective, opening laterally; in imperfect flowers reduced to 2, or even 1 only, placed between two sepals. Female flowers surrounded by a perianth like that of the male. Bracteæ 3 or 4, so placed that each sepal has one of them opposite to it (in *P. orientalis* wanting). Sepals 3 or 4, mostly opposite the carpels, elongated, club-shaped, having the internal side somewhat concave and the external rounded or acuminated; the apex thickened, truncate and projecting; the base attenuated and incurved to the ovary, to which it belongs. Barren stamens or petaloid bodies usually the same in number as the sepals and alternate with them, unequal, and irregular in form, unguiculate, colourless, sometimes very minute; in imperfect flowers very unequal or wanting. Carpels 5, 6, or 7, rarely 8; in the smaller capi-

* In *Platanus orientalis* there is much variety in the appearance of the capitula of the female flowers: frequently the flowers are so crowded on each other, that their parts become so intermixed as to be undistinguishable, so that no regular structure of any kind can be made out, which may have been the occasion of the ovary having been regarded as consisting of a single carpel; in others, especially in young fast-growing trees, there are some flowers which maintain a regular appearance: here and there are seen 5 or 6 carpels forming a whorl, with their ventral sutures approximated in the centre; and in some large trees, the inflorescence of which consisted entirely of female capitula, the flowers were nearly all distinct, having usually from 4 to 7 carpels. In one specimen of *P. occidentalis*, also, the flowers were quite as distinct, and the carpels as numerous.

tula frequently reduced to 4, 3, or 2. Ovule pendulous, orthotropal, the secundine visible through the foramen of the primine, from which it is so readily separable as to appear not at all adherent. (Pl. VI. figs. 9, 10, 11, 12 & 13.)

By the ordinary rules, therefore, by which affinities are determined, there exists only a distant analogy between Plataneæ and the Urtical and Amental families, of which they have so much the habit, their inferior radicle also being without parallel among them, where the seed is pendulous; and the only families to which it appears possible to consider them as nearly allied are Tiliaceæ and Aceraceæ, with the latter of which, as they exhibit a tendency to a polygamous inflorescence, Plataneæ may be associated, the habit also being very similar, so much so that an American species has been called 'Sycamore*.'

And while Aceraceæ approach Plataneæ in their tendency to diclinism, there is also a tendency on the part of Plataneæ to become polygamous, consisting in the male capitula producing carpels; but at the same time that the carpels are formed, the surrounding stamens become monstrous and distorted, often bearing an ovule, so that none of the flowers become perfectly hermaphrodite; and Plataneæ agree further with Aceraceæ in their unsymmetrical flowers, the number of the carpels rarely showing any correspondence with that of the floral envelopes.

But as the genus *Christiania* among Tiliaceæ is completely apocarpous, having only small petals (or barren stamens) concealed by the ovary, Plataneæ may, notwithstanding their near agreement with Aceraceæ, be a connecting link between Phytolaccaceæ and the former, and this would not be inconsistent with their affinity to Aceraceæ, as Phytolaccaceæ nearly approach Aceraceæ through *Petiveria* and *Seguiera*.

They may also be regarded as having nearly the same kind of relation to Proteaceæ as Rosaceæ to Leguminosæ, agreeing with them in their apocarpous ovary (the carpels when two in Proteaceæ being quite separated) and inferior radicle. Possibly, also, they may be compared with the Abietinæ in their crested anthers and pendulous orthotropal ovule, bearing the same relation to them as *Casuarina* to *Ephedra*.

ALTINGIACEÆ.

The solitary genus Liquidambar on which this family has been founded has been placed with the Amentaceous tribes, it would appear partly on account of a remarkable similarity in the habit of

* Most probably *P. racemosus*. There are certainly more than two species of *Platanus*, if not more than three, as shown by the very different sepals of the male flowers.

its inflorescence, and possibly also from Dr. Blume having regarded the barren stamens of the female flowers as sepals; but as all gradations of transition occur between them and the perfect stamens (giving to the genus in some degree a polygamous character), their real nature becomes obvious. A peculiar mode of dehiscence in which the ovary separates from the tube of the calyx, has also, not improbably, occasioned the epigynous character of the flower to become so doubtful as not to deserve attention. Mr. Griffith has, however, shown that it very nearly approximates *Sedgwickia* among the Hamamelideæ; and in the following details some further agreement in structure will be found between it and that family, especially with *Bucklandia* and the genera with numerous ovules, and of which, if separated, it should undoubtedly be regarded only as a section.

Trees with alternate leaves; stipules deciduous. Flowers in dense capitula, monœcious, or less frequently polygamous. Males in cylindrical or oval catkins consisting entirely of stamens without any bracteæ or scales, except those forming the involucre; the stamens in the elongated catkins sometimes 3 or 4 or more together, as if the flower were pentandrous; otherwise attached irregularly, being placed anterior, posterior, or sideways relatively to the rachis. Females in globular heads, surrounded by an involucre of 4–6 leaves. Calyx tubular, enclosing the ovary, to which it is firmly adherent, as far as to the base of the styles, with scarcely any limb, but having a shallow, somewhat lobed rim, which probably represents the glandular disk occurring in Hamamelideæ, although it is sometimes so faintly marked as to be scarcely apparent; tubes of the calyces of the different flowers firmly adherent to each other so as to form a compact globular mass. Barren stamens of the female flowers 4 or 5, sometimes increased to 8 or 9, attached to the rim of the calyx; consisting either of dense cellular tissue only, which from compression occasions them to resemble sepals, or containing four small cavities, with or without pollen; when containing pollen, becoming occasionally dehiscent at the sides. Ovary inferior, its cavities rarely projecting above or so high as the attachment of the barren stamens (the thickened styles only being seen above the indented edge of the calyx, on which the barren stamens are inserted); 2-celled, the carpels anterior and posterior relatively to the axis, very rarely right and left; occasionally 1-celled, and consisting only of a single carpel, which is then anterior, rarely lateral. Ovules numerous, covering the surface of broad placentæ, suspended, amphitropal, having the raphe next the placenta. Seed winged laterally (*i. e.* not in

the line of the raphe and hilum); embryo lying in albumen, and nearly as long as the seed; radicle superior. Dehiscence septicidal, the carpels separating from each other and also from the tubes of the calyces, which, continuing adherent to each other, form obconical, socket-like cavities, in which the separated carpels lie unattached except by their bases*.

Chloranthaceæ.

The structure of this family may perhaps be better understood by a comparison with the Amental and Urtical alliances, especially with the Myricaceæ and Casuarineæ, than by a separate analysis of them, however extended; and although not strictly amentaceous except in the male flowers of *Hedyosmum* (which differ from those of *Liquidambar* only in the number of stamens belonging to each flower), a reference to them in connexion may be desirable, as their affinities remain so uncertain as to occasion them to be placed in widely different stations in the natural system; and the more so, because it is a question materially affecting other inquiries. The following character has been formed from a selection of carefully repeated observations.

Herbaceous plants or shrubs, with opposite, entire, stipulate leaves. Flowers unisexual or hermaphrodite, in loose spikes, or dense capitula. Calyx, in *Sarcandra,* obsolete; in *Chloranthus,* a scarcely apparent scale adherent to the anterior side of the ovary, and extending laterally; in *Ascarina,* two lateral, acute, scale-like sepals, present both in the male and female flower, but not adhering to the ovary; and in the female flower of *Hedyosmum* consisting of three sepals forming a tube, for the most part not adherent to the ovary, except at the apex, where it becomes trifid, two of its segments being lateral and one posterior. Stamen in *Sarcandra, Ascarina,* and *Hedyosmum,* single, and always anterior, 2-celled (before opening 4-celled, from a spurious, not always complete dissepiment in the line of dehiscence), terminated by a beak, the cells in *Sarcandra* being separated by a thickened connective;

* Since the above was written, I find Dr. J. D. Hooker has placed this genus in Hamamelideæ (Linn. Proc. vol. ii. p. 85); I believe, however, the character now given will prove not without interest, as being a more extended analysis both of the male and female flowers, particularly as the male flowers are more reduced than in any other epigynous genus of plants (unless among the Balanophoreæ), although now referred without doubt to a dichlamydeous family. I would suggest that the barren stamens of the female flower are analogous to the barren stamens of some genera of Santalaceæ, and with other characters, show an affinity between the two families. The calyx when the fruit has ripened becoming free, may be compared to *Raspailia.*

in *Chloranthus* having the addition of half an anther on each side, which, becoming adherent to the central perfect anther, form a monadelphous bundle; dehiscence lateral or internal. Ovary consisting of a single carpel, anterior; in *Hedyosmum* of three carpels united by their margins,—one, which is the fertile, anterior, and two obliquely posterior. Style none, or very short, occasionally very slender. Stigma simple, in *Ascarina* bifid, and in *Hedyosmum* more or less triangular, the angles opposite those of the triangular ovary, and alternate with the segments of the calyx, or consisting of one enlarged anterior lobe. Placenta a single filiform body included in the posterior side of the ovary; in *Hedyosmum* consisting of three such cords attached to the walls, alternate with the angles of the triangular ovary. Ovule single, orthotropal, pendulous from the posterior side of the ovary near the apex, in *Hedyosmum* from the apex. Embryo minute, at the apex of albumen; radicle large compared with the cotyledons, which appear as if produced by a notch in its upper extremity. (Pl. VI. figs. 14, 15, 17, 18 & 19.)

The affinity of this family with Piperaceæ is so well established as to deserve no further notice, but their relation to the Amentaceous tribes is scarcely less remarkable, if the parts of the flower are separately taken into comparison;—thus the male flowers of *Ascarina polystachya* are identical with those of *Casuarina* in consisting of one stamen always anterior, differing only in having two sepals instead of four; for although the flowers are not opposite, there is a decided tendency to form whorls consisting of three or four; and the male flowers of *Hedyosmum* correspond as far as consisting of a single stamen anterior, but are entirely naked, and without even subtending bracteæ. The monadelphous filaments of *Chloranthus*, also, may be analogous to those of some species of the Myricaceæ, where three stamens occur, one of them being anterior and two lateral, although the union of the filaments is much less complete. In the female flowers the approximation is shown by the sepals being two or three, and either free* or adherent, as in *Myrica*, the ovary also in *Hedyosmum* having the same structure as in that genus; and even the enlarged lobe of the stigma of *H. arborescens* may be compared to the elongated lobe always anterior occurring among the species of *Lacistema*.

* It seems impossible that the two lateral scales present both in the male and female flowers of *Ascarina* can be bracteæ, because if they were, scales like them would most probably occur in the other genera, which show no trace of them, particularly as this genus is much like the hermaphrodite genera, *A. lucida* having a gland in front of the ovary, apparently representing the stamen.

The Chloranthaceæ also decidedly approach Polygonaceæ in their jointed stems; in the tubular calyx of *Hedyosmum* (Pl. VI. figs. 17 & 18), which agrees with that of *Coccoloba*; and especially in the triangular fruits of *Hedyosmum* (fig. 19), which, when deprived of the calyx, so much resemble those of a *Rumex*, that, by their external appearance, they could with difficulty be distinguished. A tendency also to monadelphous stamens exists in both families, so that they may be regarded as standing in the same relation to Polygonaceæ as Casuarineæ to the Amental and Urtical families, which would account for some of the Polygonaceæ having so much the habit of Artocarpeæ, and also for their ochreate stipules, as there can scarcely be a doubt that they consist of two become connate, being sometimes partially separated, with defined margins.

There is a peculiarity occurring in the calyx of *Hedyosmum hirsutum*, or an allied species (one of those in which the female flowers are enclosed within thickened bracteæ so completely that the apex of the calyx and stigma are alone discernible), which is probably quite singular: on removing the bracteæ, it is found that the calyx does not completely cover the ovary, but has three large loop-holes as it were, so that the three flattened sides of the ovary are seen through it, although it is quite continuous at the angles, and crowns it with its three segments, as in the other species.

The question referring to the structure of the anthers appears to have arisen entirely from those of *Chloranthus* itself, as those of the other genera are all of the ordinary two-celled character, or are spuriously four-celled from induplication at the line of dehiscence,—a very common occurrence in families with two-celled anthers; and, in fact, the four-celled structure is more apparent, on a transverse section being made, both in those of *Hedyosmum* and *Ascarina*, and especially in those of the latter, which are undoubtedly single anthers, than in those of *Chloranthus*. That the anthers of *Chloranthus* agree entirely with those of the other genera, is shown by the approximation of the two central cells, by their being larger and equal in length, and also by their place of attachment to the filament, which is higher up than that of the lateral cells by half their length (Pl. VI. fig. 14). These lateral half-anthers, also, in *Chloranthus inconspicuus*, besides the attachment of their cells being nearer the base of the monadelphous filaments, are separated from the central anther by a fissure in the connective for at least half their length (fig. 15).

The stamen of *Chloranthus* may be described as having the thickened connective of that of *Sarcandra*, although not to the same degree, but it has the addition of half an anther on each

side, forming a monadelphous bundle; and each of them has also in some degree the beaked connective of that of *Hedyosmum*, the beak of the central perfect anther being longer than those of the sides. In one species of *Sarcandra*, the two cells of the anther are attached exclusively to the upper half of the broad thickened connective, and this well represents the central anther of *Chloranthus*.

It deserves notice, however, that *Sarcandra* has sometimes an additional half-anther on one side of its stamen (very rarely on both sides), which is imperfect, the line of dehiscence being faintly or not at all marked; and this, not being partially separated, as in *Chloranthus*, certainly gives it an anomalous appearance; but a comparison with the anthers of *Chloranthus* will, I think, leave no doubt as to its origin;—where no trace of a line of dehiscence exists, it may consist of only a quarter of an anther, *i. e.* of half a cell divided vertically, which occasionally does occur accidentally in ordinary anthers; its rudimentary condition, however, would perhaps better account for its imperfection. This additional half-anther also sometimes presses on the lower part of the lobe above it, occasioning it to bifurcate, which may serve as a *lusus* in the structure of anthers to assist in explaining other irregularities. (Pl. VI. fig. 16.)

In some observations relating to dorsal placentation, I some time since suggested that *Chloranthus* might be an instance of that mode of attachment of the ovule; but the structure of the ovary of *Hedyosmum*, in which there are three perfectly distinct cord-like placentæ, alternating with the three angles of the ovary, and with the lobes or angles of the stigma, shows that there is nothing unusual in the placentation of this family, and that the carpel in *Chloranthus* is consequently always anterior. And that the fertile carpel in *Hedyosmum* is also anterior, seems placed beyond doubt by the two placentæ which are attached to the anterior carpel being thicker than that on the posterior side of the ovary; the anterior carpel also projects more, which would, however, be a character of doubtful value, unless confirmed by the difference of the placentæ. (Pl. VI. fig. 19.)

XI.—*On the Anthers of* Columelliaceæ *and* Cucurbitaceæ.

By B. Clarke, Esq., F.L.S. &c.

[With a Plate.]

The affinities of Columelliaceæ remaining hitherto in much obscurity, owing probably in part to some remarkable peculiarities in the anthers having been imperfectly described, an analysis

of them may tend to remove the difficulty, if, as I will endeavour to show, their structure proves to be not at all without a parallel. Those who have noticed the stamens of *Columellia,* regard each of them as consisting of a monadelphous bundle formed of three, the anther itself being regarded as six-celled, and consequently as having three pairs of lobes, indicating the presence of three stamens: a careful examination, however, of the species has led to the conclusion that they are always single, being never more than two-celled, their plurilocular appearance being entirely due to the sinuous character of the lobes*. (Pl. VI. fig. 20.)

The anthers of the species differ but very little from each other, further than in the degree of convolution of the cells, which seems owing merely to their variable length; and a comparison of them with those of Cucurbitaceæ, especially of *Cucumis sativa* and *Bryonia dioica,* will, I believe, be a convincing proof, that if the nearest affinity of this family is not with the Cucurbitaceæ, yet there is no other to which it more closely approaches; but, for the purposes of further comparison, a short character is added.

Shrubs having the habit of Myoporaceæ and Scævoleæ, especially of the latter. Leaves opposite, without stipules. Flowers solitary, axillary, with two conspicuous bracteæ at the base of the ovary, or more or less adherent to it. Calyx superior, with five segments, which are small and acuminated, the odd one being posterior. Corolla monopetalous; limb five-lobed, in æstivation imbricated, but not quite regularly so, the same segment not being always external. Stamens two, adhering to the corolla near its base, mostly alternate with its segments, being placed between the two posterior and two lateral, but occasionally showing some irregularity, one of them, if not both, becoming opposite or uncertain in their relation; filaments thick and very short. Anthers two-celled, opening outwardly (or incumbent, the larger portion opening outwardly), the cells much elongated and tortuous, each of them being doubled on itself towards the centre of the connective, so that its two extremities closely approximate both to each other and to the extremities of the other cell. Disk epigynous, not in any degree perigynous. Ovary two-celled, the cells anterior and posterior; style short and thickened; stigma bifid, consisting of two flat, semicircular lobes. Ovules nu-

* The filament, although very thick, contains but one bundle of vascular tissue, which is quite entire and compact down to the base of the corolla, but above spreads out into tortuous meshes, along the margins of which the cells of the anther are attached, so that it is not unlike an aquifoliaceous leaf, the apex of which is bent down internally towards the base.

merous, anatropal, the greater part of them extending horizontally from the placenta, those on its upper part somewhat ascending, those on its lower rather depressed; raphe in the horizontal ovules apparently lateral.

The stamens, however, of the Cucurbitaceæ frequently consist of three, one of which is only one-celled; and the others being two-celled, and the connective in some instances deeply forked, has given rise to the opinion that the real number is five, and that they are triadelphous, and consequently that the anthers are only one-celled; but that they are in such genera only three, the one-celled anther of *Bryonia dioica* places beyond doubt. The smallest of its three stamens (Pl. VI. fig. 22) has all the characters of being imperfect and bearing only half an anther, as it is one-celled and always obviously unilateral, standing sideways in the tube formed by the calyx and corolla, having the tortuous anther-cell on one side, and showing the naked connective on the other, which in other instances of half-anthers (as in *Maranta*) is not always the case, from the filament becoming more or less twisted*. The stamens of the genera having this triandrous character while the petals are five, should rather be regarded as having relation to the three-celled ovary which remains rudimentary, and if so, such genera may be compared with *Columellia,* where, as the stamens do not appear to have any fixed relation to the segments of the corolla, they may be supposed to alternate with the two carpels, as they are both attached to the corolla laterally, the carpels being anterior and posterior.

Comparing the anthers of *Columellia* therefore with the two-celled anthers of the Cucurbitaceæ, the only difference will be that in the latter the cells are not so elongated, so that the two extremities, instead of being brought together, as in *Columellia* (Pl. VI. fig. 20), point in different directions; but even this is not constant, as in *Bryonia dioica,* whether the anther is one- or two-celled (fig. 22), the opposite ends of the cell are brought round towards each other, although not so nearly approximated as in *Columellia.* They correspond also in the lower extremity of the cell being less contorted than the upper; and in stamens of *Columellia* accidentally smaller, the cells are not more tortuous than in *Bryonia,* if so much so (fig. 21). And supposing the connective of the two cells of the anther of Cucurbitaceæ to be consolidated (which does occur in some instances where they are

* The one-celled anther of the Cucurbitaceæ seems to be owing to a tendency to unilateral stamens, as in *Bryonia dioica* it is always one of two situate on the posterior side of the flower which is one-celled, the remaining stamen being anterior; the half-anther is alternate with the petals, while the other two are opposite, which would be accounted for by supposing their relation to be with the rudimentary ovary.

less sinuous), their curvature then would be towards its centre, as in *Columellia* (fig. 20), so that the resemblance between them is so close as to show that Cucurbitaceæ approach the Monopetalous series of natural orders more by this peculiarity of their anthers than by any other parts of their structure*.

While, however, the anthers of Columelliaceæ are so identical with those of the Cucurbitaceæ as to suggest a very near affinity with that family, their nearest affinity, as regards their relation to the Monopetalæ, is most probably with the Stylidiaceæ, between which and Scævoleæ may be their true station. With Stylidiaceæ they agree in the number of the lobes of the corolla being variable, while the stamens remain two, the carpels in both being anterior and posterior, and the stamens right and left, which in Stylidiaceæ becomes obvious by tracing the filaments down to their origin; the only apparent difference consisting in the stamens of Stylidiaceæ adhering to the style instead of to the corolla, and in the anther-lobes not being sinuous; but when it is recollected that these differences may occur among the genera of the same family, as in Cucurbitaceæ (so far as that the stamens are either entirely distinct and separated from each other, or form a monadelphous bundle in the centre of the flower), their approach must be very close.

EXPLANATION OF PLATE VI.

Fig. 1. A young fruit of *Myrica quercifolia* seen from above, the two stigmas remaining attached.

Figs. 2, 3 & 4. Transverse sections of it, showing the relations of the stigmas to the internal structure of the ovary; viz. that they are opposite shallow depressions in the cavity, which are continued by distinctly marked lines to the thin cellular epicarp. *Fig.* 4. Section near the base.

Fig. 5. A young fruit of *M. quercifolia*, having three stigmas, seen from above.

Figs. 6 & 7. Transverse sections of it, showing the relation of the stigmas to the internal structure of the ovary, and that it consists of three nearly equal carpels united by their margins, the tendency to dehiscence being at the dorsal sutures. *Fig.* 7. Section near the base.

Fig. 8. A female flower of *Cannabis sativa*, showing the adherent calyx: *a*, the posterior side.

Fig. 9. A male flower of *Platanus orientalis*, artificially expanded to show the sepals; beneath the filaments are seen scale-like bracteæ.

Fig. 10. One of the bracteæ of the male flower.

Fig. 11. A female flower of the same, showing the calyx and barren stamens or petaloid bodies, alternating with the sepals.

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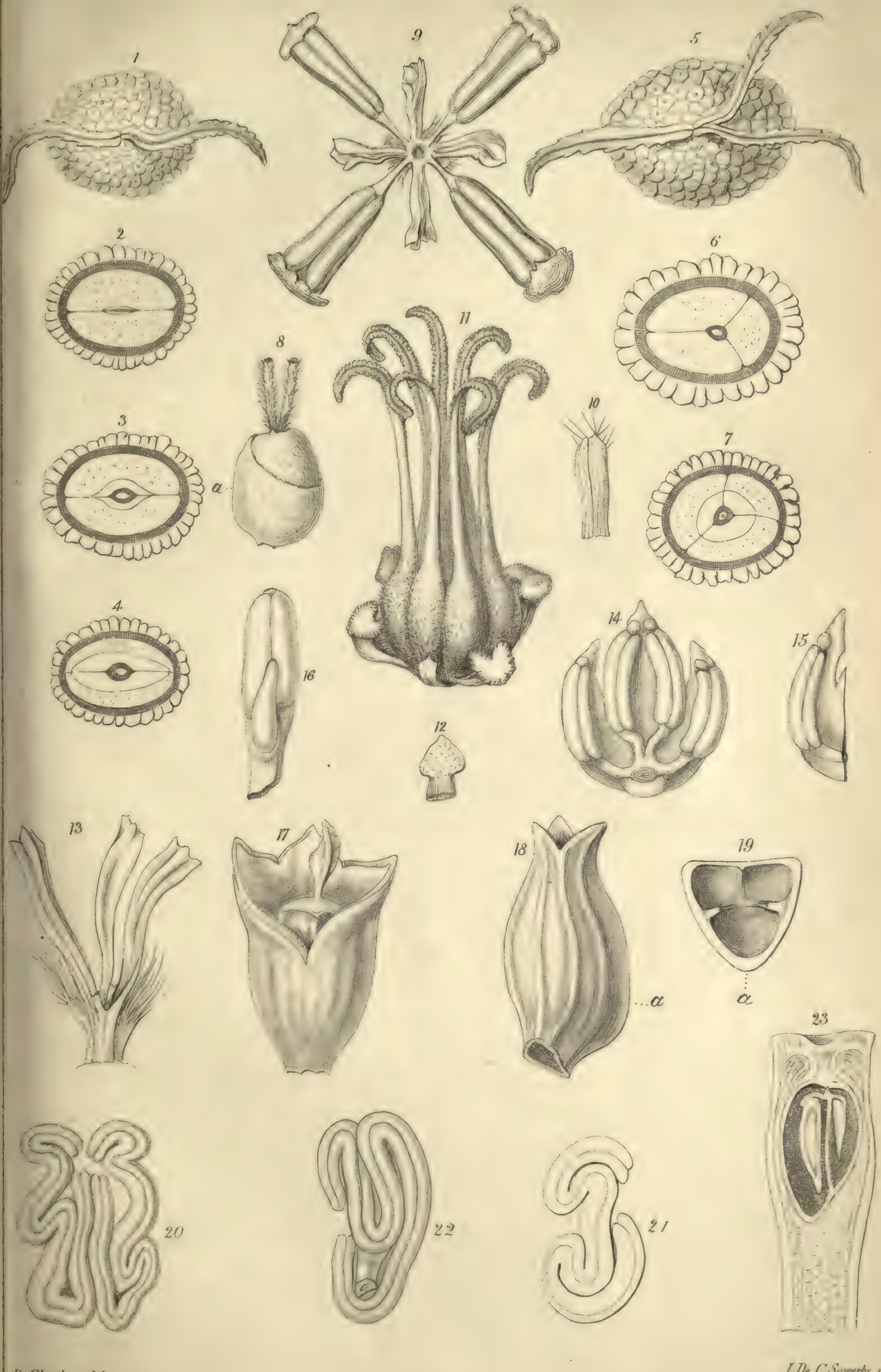
* The affinity of Cucurbitaceæ to Campanulaceæ has been traced by Auguste de St. Hilaire from other characters; they may, however, be nearer Lobeliaceæ than to that family, on account of the occurrence of unisexuality in the latter, and also of the union of their anthers.



B. Clarke del.

J. De C. Sowerby sc.

Fig. 12. A barren stamen or petaloid body, more highly magnified; their forms are variable.

Fig. 13. Calyx of the male flower of *Platanus occidentalis*, showing the bases of two stamens, with two of the bracteæ left attached at the base of the short pedicel.

Fig. 14. The monadelphous bundle of stamens of *Chloranthus inconspicuus*; the scar shows the contracted base by which it is attached to the rudimentary calyx on the anterior side of the ovary.

Fig. 15. One of the half-anthers of *Chloranthus inconspicuus* cut off, and showing the extent to which its connective is unattached to that of the central anther.

Fig. 16. A stamen of a *Sarcandra* seen laterally, showing one of the cells only, which has an additional but imperfect half-anther pressing on it so as to make it bifurcate at its lower part.

Fig. 17. A female flower of *Hedyosmum nutans*, the calyx having been partially separated to show the style and stigma.

Fig. 18. A fruit of *Hedyosmum glabrato-affinis* crowned by the trifid calyx: *a*, the anterior angle.

Fig. 19. A transverse section of the ovary, more magnified, showing its cavity, the calyx having been removed from it: *a*, the anterior angle. In other species of this genus the same difference in the placentæ may be observed, although it is not so strongly marked; and there is also some difference in the anterior angle of the ovary.

Fig. 20. An anther of *Columellia oblonga*, the cells being flattened so as to show their convolutions and their relation to each other: the lower end of the figure represents the external side of the anther, its apex or most elevated part being near the centre towards the opposite extremity, so that the four ends of the lobes meet rather on the internal side.

Fig. 21. One of the cells of an anther of a *Columellia*, in which the stamen was accidentally smaller.

Fig. 22. The half-anther of *Bryonia dioica* flattened sufficiently to show all its convolutions: the convex side is external; below is seen a portion of the filament.

Fig. 23. An ovary of a *Lophophytum* (*L. Weddellii*, or very near it) in longitudinal section; the dissepiment apparently quite free above.

XII.—*Brief Diagnostic Characters of undescribed Madeiran Insects.* By T. Vernon Wollaston, M.A., F.L.S.

[With two Plates.]

[Concluded from p. 28.]

Ordo DIPTERA.

(Sectio I. Proboscidea.)

Genus Dilophus, Meig.

Dilophus Maderæ. Pl. V. fig. 1.

D. mas ater; alis fusco-cinereis.—Long. corp. 2, alar. $3\frac{1}{2}$ lin.

Inhabits Madeira proper; occurring in the sylvan districts

(S. Antonio da Serra, Ribeiro Frio, &c.) of intermediate elevations.

Genus Scatopse, Geoffr.

Scatopse tristis. Pl. V. fig. 2.

S. atra; pedibus validis, femoribus tibiisque anticis partim testaceis; alis cinereis.—Long. corp. $1\frac{1}{4}$, alar $2\frac{1}{2}$ lin.

Inhabits Madeira proper, abounding at times in certain spots at intermediate altitudes. On the 10th of August 1855, I observed it, on the wing, in a small limestone cavern at the Forno de Cal, near São Vincente, in such countless myriads that the air appeared absolutely darkened by it.

Genus Cheironomus, Meig.

Cheironomus pedestris.

C. fœm. obscure fuscus; palpis testaceis; pedibus longis validis, femoribus basi testaceis; alis fuscis, halteribus albis.—Long. corp. $1\frac{1}{2}$, alar. 3 lin.

Inhabits the Dezerta Grande; occurring also, I believe, on the Southern Dezerta and in Porto Santo.

Genus Limnobia, Meig.

Limnobia contraria.

L. nigra; antennis albidis; thoracis disco abdominisque apice testaceis; pedibus flavis, femoribus, tibiis tarsisque apice nigris; alis luteis, fascia arcuata nigra ornatis.—Long. corp. $4\frac{1}{2}$, alar. 9 lin.

Inhabits Madeira proper, occurring about the fountains and water-courses of a lofty elevation. I have taken it rather commonly at the Cruzinhas in July.

Limnobia Maderensis.

L. fusca; antennis palpisque subnigris; thorace flavo, vittis tribus ferrugineo-fuscis ornato, lateribus albidis; abdomine subtus flavo; femoribus fulvis, apice nigris; alis cinereis.—Long. corp. $2\frac{1}{2}$–3, alar. $6\frac{1}{2}$–7 lin.

Inhabits Madeira proper, occurring in similar spots as the last species.

Limnobia haligena.

L. fusca; antennis palpisque nigrescentibus; abdominis apice dilutiore; pedibus robustis; femoribus tibiisque ad apicem tarsisque nigrescentibus; alis fusco-cinereis.—Long. corp. $3\frac{1}{2}$, alar. $6\frac{1}{2}$–$7\frac{1}{2}$ lin.

Inhabits Porto Santo and the Southern Dezerta.

Limnobia Atlantica.

L. pallide flavo-fusca, gracilis; antennis palpisque vix obscurioribus; thorace in disco abdominisque apice dilutioribus; pedibus longis gracilibus, femoribus, tibiis tarsisque ad apicem ipsum nigrescentibus; alis breviusculis, læte submaculatis.—Long. corp. 3–3½, alar. 5½ lin.

Inhabits Porto Santo.

Genus Pachyrhina, Macq.

Pachyrhina brevipennis.

P. flava; capitis vitta, antennis palpisque nigris; thorace fusco-trivittato; abdomine nigro, segmentis antice flavis; alis abbreviatis, subcinereis.—Long. corp. 8½, alar. 8½ lin.

Inhabits Madeira proper, occurring in moist spots of a lofty altitude. In July 1850 it was not uncommon at the Cruzinhas.

Genus Thereva, Lat.

Thereva nana. Pl. V. fig. 3.

T. fusco-cervina; capite cano, antennis nigris; abdomine fusco, fasciis, apice pedibusque testaceis; alis fulvescentibus, halteribus pallidis.—Long. corp. 2¾, alar. 5 lin.

Inhabits the Dezerta Grande, on which island I captured it at the end of May 1850.

Fam. SYRPHIDÆ.

Genus Eristalis, Lat.

Eristalis ustus.

E. piceus, fusco-hirtus; abdominis basi fulvo interrupte fasciata; antennis pedibusque nigris; tibiis basi fulvis; alis cinereis.—Long. corp. 7, alar. 14 lin.

Inhabits Madeira proper.

Genus Paragus, Lat.

Paragus mundus. Pl. V. fig. 4.

P. nigro-chalybeus; epistomate testaceo; antennis nigris; pedibus albidis, femoribus basi nigris, tibiis ad apicem tarsisque luteis; alis hyalinis.—Long. corp. 2½, alar. 4½ lin.

Inhabits Madeira proper (São Vincente, Ribeiro Frio, near Funchal, &c.), and Porto Santo.

Fam. MUSCIDÆ.

Genus Tetanocera, Dum.

Tetanocera inclusa. Pl. V. fig. 5.

T. fulva; capite subtus albido; antennis nigris, basi fulvis; thorace fusco, vittis tribus, lateribus pectoreque canis; abdomine nigricante, segmentis fulvo-fasciatis; alis cinereis, costa maculisque discalibus nigro-fuscis.—Long. corp. $2\frac{3}{4}$, alar. $5\frac{1}{2}$ lin.

Inhabits Madeira proper, at intermediate altitudes: Feijãa de Córte, August 1850.

Tetanocera? Walkeri. Pl. V. fig. 6.

T. cinerea; capite subtus albido, oculis viridibus; antennis testaceis; thorace fere concolori; abdomine antice dense piloso; pedibus dilute testaceis; alis hyalinis albis, maculis plurimis nigris discalibus confluentibus ornatis.—Long. corp. $3\frac{3}{4}$, alar. 6 lin.

Inhabits Madeira proper; captured at Santa Cruz early in June 1855.

Genus Acinia, Desvoid.

Acinia insularis.

A. nigra, cano-tomentosa; capite albido, disco luteo; antennis fulvis; thorace vittis quinque fuscis ornato; pedibus fulvis, femoribus nigris; alis nigro-fuscis, albo confertim guttatis.—Long. corp. $1\frac{1}{4}$–$1\frac{3}{4}$, alar. 3–$3\frac{1}{2}$ lin.

Inhabits Madeira and the Northern Dezerta.

Acinia valida.

A. nigra, cinereo-tomentosa; capite flavo, subtus albo; antennis luteis; pedibus fulvis; alis albidis, cinereo-nebulosis.—Long. corp. $1\frac{1}{2}$, alar. 3 lin.

Inhabits Madeira, Porto Santo, and the two southern Dezertas.

Acinia Miranda.

A. nigra, cinereo-tomentosa; capite antennisque luteis; pedibus fulvis; alis albidis, læte nigro-pictis, costa, apice plagaque transversa ultra medium sita nigrescentibus.—Long. corp. $1\frac{1}{2}$, alar. vix 3 lin.

Inhabits Porto Santo; detected during the spring of 1855.

Genus Ensina, Desvoid.

Ensina decisa.

E. nigra, cano-tomentosa; capite ferrugineo, sat longo, vittis duabus albidis ornato, subtus flavo; antennis fulvis; thorace ad latera

flavo, abdomine nigro, marginibus flavis; pedibus fulvis; alis albidis, maculis 9 vel 10 nigricantibus irroratis.—Long. corp. $1\frac{1}{4}$–$1\frac{1}{2}$, alar. 3 lin.

Inhabits Madeira and the two northern Dezertas.

Ensina vacillans.

E. nigra, cinereo-tomentosa; capite luteo, subproducto; pedibus fulvis, femoribus posticis basi nigris; alis dilute albidis, fusco-nebulosis, costa venisque transversis obscurioribus.—Long. corp. 1–$1\frac{1}{2}$, alar. $2\frac{1}{4}$–$2\frac{3}{4}$ lin.

Inhabits Madeira proper, occurring near Funchal.

Genus Drosophila, Fallen.

Drosophila repleta. Pl. V. fig. 7.

D. fusca, thorace vittulis plurimis nigrescentibus irroratis; antennis basi pedibusque testaceis; alis fulvo-subcinereis, halteribus albidis. —Long. corp. $1\frac{1}{2}$, alar. $3\frac{1}{4}$ lin.

Inhabits Madeira proper, occurring in the houses of Funchal.

Genus Gymnopa, Meig.

Gymnopa clara. Pl. V. fig. 9.

G. cuprea; antennis testaceis, articulo tertio ad apicem fusco; abdomine æneo-viridi; pedibus testaceis, femoribus nigris; alis fulvis.—Long. corp. $\frac{3}{4}$, alar. $1\frac{2}{3}$ lin.

Inhabits the Northern Dezerta; occurring also on the Ilheo de Fora (the detached extremity of the Ponta São Loarenço) of Madeira proper.

Genus Oscinis, Lat.

Oscinis signata. Pl. V. fig. 8.

O. æneo-nigra, obscura; capite thoraceque vittis plurimis flavis ornatis; antennis fulvis; scutello nigro; pedibus testaceis, femoribus nigris, tibiis posterioribus nigro-fasciatis; alis albidis, halteribus nigris.—Long. corp. 1, alar. 2 lin.

Inhabits Madeira proper; abounding at times in the houses of Funchal.

Ordo LEPIDOPTERA.

Fam. LEUCANIDÆ.

Genus Nonagria, Ochs.

Nonagria Sacchari.

N. alis anticis lutareis, puncto nigro plicæ ante medium, altero disci

in medio, serie curvata punctorum nigrorum pone medium, linea transversa nigra fere ad marginem postremum; alis posticis albidis, immaculatis.—Exp. alar. $17\frac{1}{2}$ lin.

Inhabits Madeira proper, and has probably been imported into the island, being extremely destructive to the sugar-canes. The caterpillar, which may be taken during the summer months, lives in the interior of the stem, where it does incalculable damage to the cane,—more or less spoiling the entire crop. I am indebted for an excellent specimen of the imago to C. Bewicke, Esq., who reared several of them in Funchal during the autumn of 1855, and who communicated to me some interesting observations concerning the habits of the insect. It appears totally distinct from the *Diatræa sacchari* of the Rev. Lansdown Guilding (Trans. of the Soc. of Arts, vol. xlvi. p. 148, A.D. 1828); as also from the *Proceras sacchariphagus*, Bojer (described in the 'Report of the Committee on the Cane-borer,' and published at the Mauritius), which belongs to an altogether different family, the *Pyralidæ*; as well as from the *Noctua sacchari* of the 'Papillons de Surinam' (pp. 135, 136. pl. 64. A.D. 1848).

Fam. GEOMETRIDÆ.

Genus Hemithea, Boisd.

Hemithea nubigena.

H. alis viridibus, striga posteriore alba communi subindistincta ornatis, costa alarum anteriorum albido-ochracea.—Exp. alar. 9 lin.

Inhabits Madeira proper, occurring among the heath-woods of the loftiest elevations. Whilst encamped on the extreme summit of the Pico Ruivo (upwards of 6000 feet above the sea) early in August 1850, it flew into my tent in great abundance, attracted by the light of the candle, after sunset.

Genus Eubolia, Boisd.

Eubolia rupicola.

E. alis anticis fuscis, saturatiore lineatis, striga anteriore parum angulata, striga posteriore (extus dentem emittente et albido-marginata), punctis dilutis, maculisque duabus marginem posticum versus nigro-fuscis ornatis.—Exp. alar. 16 lin.

Inhabits Madeira proper; abounding at intermediate elevations throughout the sylvan districts; and secreting itself generally beneath the overhanging projections of the rocks, which it more or less resembles in colour.

Genus Coremia, Guér.

Coremia centro-strigaria.

C. alis anticis griseo-ochreis, basi ac area centrali rufescentibus, hæc fasciam nigram extus prope costam acute angulatam includens.—Exp. alar. 12 lin.

Inhabits Madeira proper; and is allied to the *C. Ligustraria* and *ferrugaria* of more northern latitudes.

Fam. CRAMBIDÆ.

Genus Crambus, Fab.

Crambus Atlanticus.

C. alis anticis apice acutis, saturate griseo-ochreis, costa anguste albida, dorso basin versus albido, vitta centrali albida a basi perducta, pone medium in ramos fracta plagaque fusca interrupta; plaga hæc postice nigro et albo marginata est; palpis longiusculis; antennis filiformibus, nec pectinatis; capite vittaque centrali thoracica albis.—Exp. alar. 13 lin.

Inhabits Madeira proper; abounding in grassy spots, during the summer months, at intermediate and lofty elevations.

Genus Eudorea, Curt.

Eudorea stenota.

E. alis anticis angustis apice acuto, strigis duabus albidis postice late nigricanti-marginatis, priore acute fracta, posteriore tenui bi-arcuata, punctis duobus nigris cum strigæ prioris umbra confluentibus, signo ♉ obliquo; posterioribus cano-albidis.—Exp. alar. vix 11 lin.

Eudorea stenota, Zell., in litt.

Inhabits Madeira proper; abounding in grassy spots, chiefly of a rather lofty elevation.

Eudorea Scoriella.

E. alis anticis subangustis pulverato-fuscis, strigis duabus tenuibus arcuatis, externe latius fusco-marginatis, signo ♉ obscurius expleto, spatio ante-marginali latiusculo, superius nigro-lineato, posterioribus fusco-cinereis. ♂ ♀.—Exp. alar. vix 11 lin.

Eudorea scoriella, Zell., in litt.

Inhabits Madeira proper, occurring in similar spots as the last species.

Fam. TORTRICIDÆ.

Genus Tortrix, Treitsch.

Tortrix subjunctana.

T. alis anticis griseis, saturate rufo-griseo irroratis, striga parum angulata rufo-grisea ante medium, macula obsoleta in costæ medio, maculaque distinctiore dorsali angulum analem versus, saturate rufo-griseis.—Exp. alar. 10 lin.

Inhabits Madeira proper, having been captured by myself in a house at Ribeira da Janella, in the north-west of the island. I am informed by Mr. Stainton that it is allied to the European *T. adjunctana.*

Genus Ephippiphora, Dupon.

Ephippiphora Maderæ.

E. alis anticis griseis saturatius nebulosis, strigis multis costæ saturate griseis, obliquis, et pone medium lineis plumbeis angulatis transversis, lunula dilutiore in medio dorsi oblique posita, ac sine linea centrali distincta, specula supra angulum analem, lineis tribus nigris.—Exp. alar. 6½ lin.

Inhabits Madeira proper; and is very closely related, as I am informed by Mr. Stainton, to the *E. Leplastriana,* Curtis; it is however greyer than that species, the markings also are more oblique, and the anterior wings are a trifle narrower.

Fam. TINEADÆ.

Genus Tinea, Fab.

Tinea irrorella.

T. alis anticis saturate fuscis atomis albidis irroratis, costa angustissime albida; capillis ferrugineis; antennis tenuibus longiusculis; abdomine ♀ postice ensiformi.—Exp. alar. 8½ lin.

Inhabits Madeira proper.

Tinea abruptella.

T. alis anticis brunneis, pone medium abrupte albis, postice dilutissime griseo-nebulosis; capillis (et thorace?) albis.—Exp. alar. 10 lin.

Inhabits Madeira and Porto Santo. It resembles, according to Mr. Stainton, the European *T. tapetzella,* but the basal half of its anterior wings is brown (not black), perpendicularly cut off, and there is no grey blotch at the apex.

Genus Gelechia, Hübn.

Gelechia pulchra.

G. alis anticis rufo-brunneis, dorso albido, punctis tribus disci nigris cum duobus albis alternantibus, fascia postica albida fere recta; capite thoraceque lacteis.—Exp. alar. 4 lin.

Inhabits the Dezerta Grande, where it was captured by myself in June 1855. According to Mr. Stainton, it is closely allied to the *G. marmorea* of higher latitudes; but the hind fascia is straighter (as in *G. punctella*), and the head, thorax, and the inner margin of the anterior wings are cream-coloured.

Gelechia nigromaculata.

G. alis anticis albis, punctis tribus nigris costæ, uno basali, secundo ante et tertio pone medium, maculis duabus nigris dorsi, una ante (interdum cum puncto secundo costæ connexa), altera pone medium; apice nigro-punctato; capite thoraceque albis.—Exp. alar. 5 lin.

Inhabits Madeira and the Southern Dezerta; having been captured by myself on the latter at the beginning of June, and in the former (at Feijãa d'Ovelha) at the beginning of July 1855.

Genus Œcophora, Lat.

Œcophora marmorosella.

Œ. alis anticis griseis, saturatius marmoratis, fascia ante medium subdistincta, punctis duobus nigris oblique positis pone fasciam, primo disci, secundo supra plicam, punctis duobus nigris confluentibus pone medium inter maculas fuscas oppositas; apice fusco-punctato.—Exp. alar. $7\frac{1}{2}$–9 lin.

Inhabits Madeira, Porto Santo, and the Northern Dezerta; being more particularly abundant in the second of those islands, where I captured it in profusion (principally in my tent) during April and May 1855. It is allied to the *Œ. pseudospretella* of more northern latitudes; but the anterior wings are much narrower and more pointed, and with a cloudy fascia.

Œcophora ochreopalpella.

Œ. alis anticis fuscis, puncto subobsoleto saturatiore disci pone medium; capite fronteque ochreis; palporum articulo tertio ochreo. —Exp. alar. $6\frac{1}{2}$ lin.

Inhabits Madeira proper.

Genus Gracilaria, Haw.

Gracilaria Staintoni.

G. alis anticis dilute aureis, dorso purpureo-irrorato, costa parum

nigro-punctata, plaga marginem posticum versus fusca.—Exp. alar. 6½ lin.

Inhabits Madeira proper, where it was detected by myself during the summer of 1855. I have dedicated the species to my friend H. T. Stainton, Esq., from whom I have obtained much valuable information respecting the minute Lepidoptera here described.

Gracilaria ? aurantiaca.

G. alis anticis luteo-brunneis, postice dilutioribus, macula dorsali basin versus trianguloque dorsi pone medium luteis.—Exp. alar. 5½ lin.

Inhabits Madeira proper; captured by myself during the summer of 1855.

Genus Coleophora, Zell.

Coleophora Desertarum.

C. alis anticis luteo-ochreis, costa, dorso venisque posticis dilute griseis, puncto plicæ nigro ante medium, aliis parvulis pone medium, apice nigro-punctato; antennis griseis, haud annulatis, articulo basali incrassato haud penicillato.—Exp. alar. 6 lin.

Inhabits the Northern Dezerta, where it was detected by myself early in June 1855.

Genus Laverna, Curt.

Laverna vittata.

L. alis anticis dilutissime ochreis, vitta media a basi usque ad marginem posticum perducta, brunnea.—Exp. alar. 6½ lin.

Inhabits Madeira proper; and bears a considerable resemblance to the European *Gelechia interruptella.*

Laverna ? decolorella.

L. alis anticis ochreis, striga obliqua ex medio dorsi fusca, stria abbreviata ex angulo anali introrsum spectante, altera opposita costæ extrorsum spectante, fuscis.—Exp. alar. 8 lin.

Inhabits Madeira proper; and I am informed by Mr. Stainton that it will probably constitute the type of a new genus. "It differs," he says, "from *Laverna* in the thickened terminal joint of its palpi; indeed in its *thick, recurved* palpi it resembles no known genus,—wanting the tuft of *Chelaria.* The posterior wings, too, are much too broad for *Laverna.*"

Genus Asychna, Staint.

Asychna insularis.

A. alis anticis saturate olivaceo-fuscis, stria angusta aurantiaca a costæ basi ad medium disci perducta, postice striis tribus vel quatuor interruptis aurantiacis; tibiis flavis.—Exp. alar. 5 lin.

Inhabits Madeira proper; occurring amongst damp fern and herbage in the moist sylvan districts of intermediate and lofty elevations. At the head of the S[ta] Cruz ravine, at S. Antonio da Serra, I observed it abundantly during June 1855.

Ordo HEMIPTERA.

Genus *Pirates*, Burm.

Pirates niger.

P. obscure niger, nitidiusculus; thoracis sulco longitudinali haud profundo, postice distinctissimo; scutello incrassato, medio cavato; hemelytris fusco-nigris, immaculatis; pedibus anticis incrassatis, tibiis apice subspathulatis.—Long. corp. $5\frac{1}{2}$ lin.

Inhabits Madeira proper; exceedingly rare. Detected by myself, on the 6th of December 1848, beneath fallen leaves at S. Antonio da Serra.

Genus Sciocoris, Fallen.

Sciocoris Sideritidis.

S. umbrinus, griseo-variegatus, densissime rugoso-punctatus; hemelytrorum membrana fusco-punctata; capite supra subunicolori, antice obtuse rotundato; scutello ad apicem partis coriaceæ hemelytrorum vix extenso.—Long. corp. $2\frac{1}{4}$–$2\frac{3}{4}$ lin.

Inhabits Madeira and the Dezerta Grande; occurring on the foliage of the *Sideritis Massoniana*, Benth., during the spring and summer months; and amongst fallen leaves at the roots of that plant, and of the *Sempervivum patina* (Lowe, MS.) during the winter. It is closely allied to the European *S. umbrinus* (likewise found in the Madeira islands); it is, however, smaller than that insect, its hemelytra are not quite so long (being usually slightly shorter than the abdomen), its colour is darker, or of a redder brown, its punctuation somewhat more dense, its scutellum (although large) is proportionably smaller, and its head is blunter (or less pointed) in front.

Genus Rhyparochromus, Curt.

Rhyparochromus Maderensis.

R. supra sparse et rude punctatus; capite, thorace scutelloque nigro-

brunneis, thoracis lateribus anguste pallido-marginatis; hemelytris brunneis, basi pallidis; pedibus pallide flavis, femoribus obscuris, tibiis anticis subcurvatis.—Long. corp. $3\frac{1}{2}$–4 lin.

Inhabits Madeira proper; occurring at intermediate elevations, especially in the pine-woods towards the south of the island.

Genus Phytocoris ?, Fallen.

Phytocoris ? Whitei.

P. nigro-fuscus, hirtulus; antennis pedibusque pallidis, femoribus posticis basi fuscis, antennis medio fusco uni-annulatis; capite fusco, postice pallido; thorace, scutello hemelytrorumque plagis duabus triangularibus nigro-fuscis.—Long. corp. $1\frac{1}{2}$–vix 2 lin.

Inhabits Madeira proper; being confined apparently to the *Echium candicans,* Linn. fil., of intermediate and lofty elevations. I first detected it at the Feijaa de Córte, early in August 1850,—in company with the *Meligethes Echii,* the *Longitarsus Masoni,* and the *Tingis indigena,* all of which would seem to be peculiar to that plant. I have dedicated the species to my friend Adam White, Esq., of the British Museum, who has paid so much attention to the Hemiptera, and who informs me that the present insect will probably constitute the type of a new genus.

Genus Capsus ?, Fab.

Capsus ? obesulus.

C. punctulatus, rotundato-ovatus, obscuro-fuscus, subviridi-tinctus, breviter pubescens; capite rufescente; hemelytrorum membrana fusca, macula apicali alba.—Long. corp. $\frac{7}{8}$ lin.

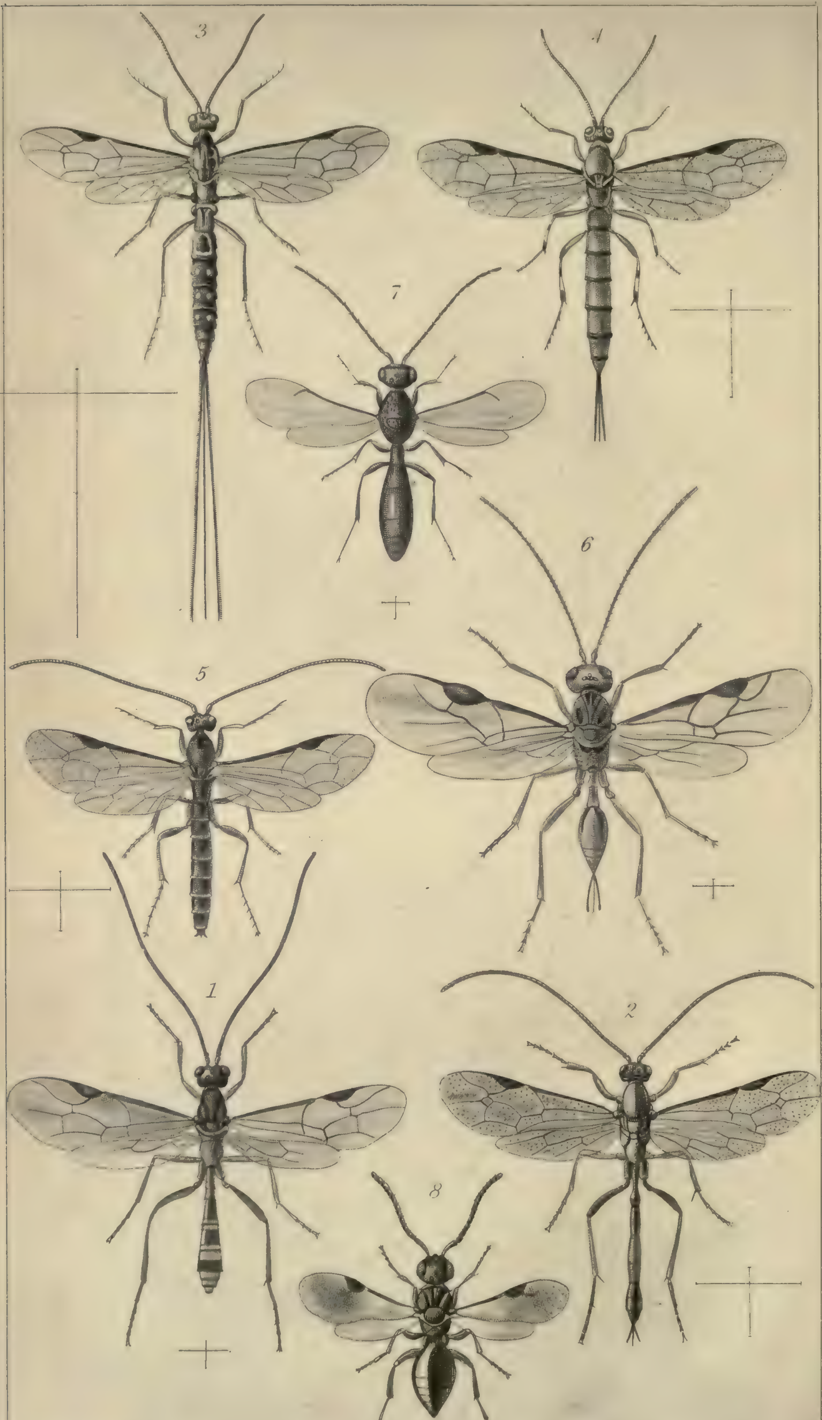
Inhabits Madeira proper; occurring amongst fern and herbage throughout the sylvan districts, especially in damp spots. It is a truly indigenous insect, and is more especially abundant in the north of the island.

Genus Tingis, Fab.

Tingis indigena.

T. longe ovatus, supra argentato-vitreus, nigro-variegatus; thoracis dorso nigro, tricarinato, carinis albidis, mediana elongata; hemelytris delicatule nigro-reticulatis; capite nigro, supra albo-bilineato; antennis pallide flavis, articulo ultimo apice subincrassato nigro; pedibus pallide flavis, femoribus basi fusco-ferrugineis, tarsis apice subnigris.—Long. corp. $2\frac{1}{3}$ lin.

Inhabits Madeira proper; being attached, like the *Phytocoris Whitei,* to the gigantic *Echium candicans,* on the foliage of



Westwood, del.

J. Basire, sc

Westwood, del.

J. Basire, sc.

which I observed it (both in the pupa and imago state) in considerable abundance at the Feijãa de Córte, early in August 1850.

EXPLANATION OF THE PLATES.

PLATE IV.

1. Misoleptus Maderensis, *W.*
2. Exetastes peregrinus, *W.*
3. Ephialtes lateralis, *W.*
4. —— lineatus, *W.*
5. Lissonota dorsalis, *W.*
6. Perilitus debilis, *W.*
7. Scelio minor, *W.*
8. Ceraphron parvulum, *W.*

PLATE V.

1. Dilophus Maderæ, *W.*
2. Scatopse tristis, *W.*
3. Thereva nana, *W.*
4. Paragus mundus, *W.*
5. Tetanocera inclusa, *W.*
6. ——? Walkeri, *W.*
7. Drosophila repleta, *W.*
8. Oscinis signata, *W.*
9. Gymnopa clara, *W.*

XIII.—*Notice of three new species of* Sinusigera, *a genus of Brachiocephalous Mollusks.* By ARTHUR ADAMS, F.L.S. &c.

To the Editors of the Annals of Natural History.

GENTLEMEN, Hong Kong, Nov. 12th, 1857.

While traversing the Indian Ocean and China Sea, on our passage from the Cape to Hong Kong, the towing-net was put over whenever the state of the weather and the speed of the vessel permitted. By this means a slender linear area of those portions of the surface of the high seas crossed by us was imperfectly examined. The results of such limited investigation have already enabled me to make you acquainted with several very interesting forms of pelagian Mollusks; and I now avail myself of your pages to notice the existence of three new species of the *Sinusigera* of D'Orbigny or *Cheletropis* of Forbes.

1. *Sinusigera vitrea*, A. Adams.

S. testa vitrea, semipellucida, perparva; spira elata, conica; anfractibus quinque, ultimo striis undulatis longitudinalibus ornato, ad peripheriam carina valida cincto et carina spirali antice instructo; labio arcuato, in mucrone simplici desinente; labro postice valde sinuato, margine incrassato, lobo rotundato in medio producto, lobo postice spina angulata armato.

Hab. in Mare Sinense.

Shell vitreous, semi-pellucid; spire conical, longer than the aperture; whorls five, the last marked with longitudinal, undulating striæ, and encircled with a prominent filiform keel at the periphery, and with another spiral ridge at the fore part; inner lip curved inwards and regularly arcuate, ending anteriorly in a simple point; outer lip deeply sinuated, the thickened margin posteriorly forming a rounded lobe, the upper or hind part of which is produced into a short angular process.

Hab. China Sea. Gregarious. Captured at the surface in the towing-net. This is the smallest species I have yet met with, and is very different in form from the others.

2. *Sinusigera trochoides*, A. Adams.

S. testa trochoidea, albida; spira brevi, conica; anfractibus 3–4 planiusculis, ultimo lineis longitudinalibus undulatis ornato, ad peripheriam angulato et carina filiformi circumcincto; labio arcuato, antice excurvato, ad terminationem truncato et emarginato; labro margine incrassato, valde sinuato et bilobato, lobo antico valde producto, subspinoso.
Hab. in Oceano Indico.

Shell somewhat top-shaped, whitish, thin; spire short and conical; whorls 3–4, rather flattened, the last adorned with fine, wavy, longitudinal lines, and angulated at the periphery, encircled also with a filiform keel; inner lip arched, curved outwards in front, and with the fore part truncate and emarginate; outer lip with the margin thickened and deeply sinuated and bilobed; the anterior lobe greatly produced, and somewhat spinose.

Hab. Indian Ocean. A single specimen only of this peculiar species was obtained in the towing-net.

3. *Sinusigera glabra*, A. Adams.

S. testa ovato-conica, glabra, nitida, rufo-fusca; spira aperturam æquante; anfractibus $3\frac{1}{2}$, convexiusculis, ultimo vix angulato, carina filiformi circumcincto; labio regulariter arcuato, antice truncato; labro margine incrassato, valde sinuato et bilobato, lobo postico majori, truncato; lateribus productis, lobo antico minori et truncato.
Hab. in Oceano Indico.

Shell ovately conical, smooth, shining, reddish-brown; spire equalling the aperture in length; whorls $3\frac{1}{2}$, rather convex, the last encircled with a filiform keel; inner lip regularly arched and truncate anteriorly; outer lip with the margin thickened, deeply sinuated, and bilobed; the hind lobe the largest, with the sides produced and truncate like a hammer; the anterior lobe the smaller, simple, and obliquely truncate.

Hab. Indian Ocean.

This species somewhat resembles *S. Huxleyi*, Forbes, but it is much smaller and of a different shape. It is perhaps the *Struthiolaria microscopica* of Dr. Gray. It occurred sparingly, but gregariously, and was taken by the towing-net at the surface.

I am, Gentlemen,

Yours &c.,

Arthur Adams.

XIV.—*Description of a new species of Woodpecker discovered by* Mr. Thomas Bridges *in Northern California.* By Philip Lutley Sclater, M.A.

Melanerpes rubrigularis, sp. nov.

Supra nitenti-niger; linea circum-nuchali ab oculis incipiente, altera utrinque suboculari a rictu latiore, tectricibus alarum superioribus, dorso postico et caudæ tectricibus superioribus, necnon maculis secundariarum trium extimarum apicalibus et in pogonio externo primariarum tertiæ, quartæ et quintæ albis; subtus nitenti-niger, gula media ruberrima, abdomine medio flavicante, lateribus et crisso albo nigroque variegatis; tectricibus alarum inferioribus et remigum pogoniis interioribus cinerascenti-nigris, maculis quadratis numerosis albis; caudæ rectricibus omnino nigris; rostro et pedibus nigris.

Long. tota 8·5, alæ 5·4, caudæ 3·5, rostri a fronte 1·0, tarsi 0·8.

This Woodpecker, which is represented by Mr. Bridges as very rare, appears to have escaped the researches of the American naturalists; at least, I am acquainted with no record of its existence, though it may have been described quite lately. It appears to be well placed in the genus *Melanerpes*, of which no less than six species are already known to inhabit California; namely *M. erythrocephalus*, *M. torquatus*, *M. thyroideus* (Cassin, B. Cal. pl. 32; *Picus nataliæ*, Malherbe, Cab. Journ. f. Orn. 1854, p. 271), *M. formicivorus* (Cassin, B. Cal. pl. 2), *M. albolarvatus*, and *M. ruber*. From all these it is quite different in colouring, and may be recognized at once by its black breast and bright scarlet, longitudinal throat-mark,—whence I have named it *M. rubrigularis*. The single specimen sent was procured by Mr. Bridges in Trinity Valley, Northern California, in the pine-forests.

XV.—*List of* Coleoptera *received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, Edinburgh.

[Continued from vol. xx. p. 126.]

Chlæniidæ.

Homalolachnus, Laferté, Ann. Soc. Ent. France (série 2), ix. 293.

1. *H. elongatus*, mihi.

Chlænius elongatus, mihi, Annals, 2nd series, xix. pl. 13, fig, 9. June 1857.

Capite nitido, antice subvirescenti, postice leviter punctulato; thorace nigro, angusto, confertissime et profunde punctato,

parce piloso, marginibus subcupreis; elytris nigro-viridibus, opacis, punctato-striatis, interstitiis punctatis et geminato-pilosis, maculis duabus flavis, una transversa circa medium posita, altera minore apicali; subtus niger; pedibus piceis, femoribus testaceis, tibiis anterioribus et intermediis in parte testaceis, tarsis anticis valde dilatatis in maribus.

Long. $6\frac{1}{2}$ lin., lat. $2\frac{1}{4}$ lin.

Narrow and elongate; antennæ with the two basal joints ferruginous, a piceous patch on the upper side of the first joint, the remainder black or fuscous, the fourth and following joints pubescent, flattened, and wider at the middle joints than at either end; palpi piceous. Head smooth, polished, virescent, lightly punctate behind. Thorax narrow, with a tendency to be cylindrical, but margined, narrowed both behind and in front, narrowest behind, widest about the middle; in front very much rounded-in, and anterior angles fitting close to the neck; the sides gently rounded, becoming straighter a little before the posterior angles, which are rounded and obtuse; very deeply and closely punctate; the punctuation becomes confluent towards the sides, and closest behind; sparingly pilose; margin a little raised towards the posterior angles, and having within it a little of a cupreous or æneous lustre; dorsal line distinct, reaching neither to front nor base, deepest in front. Scutellum impunctate. Elytra long and narrow, widest behind the middle, opaque, black or bluish-green, the green colour most seen when looked at from in front; punctate-striate, interstices punctate, and bearing a double row of yellowish hairs; with two yellow spots on each, the anterior broader than long, transverse, occupying the 4th, 5th, 6th, 7th and 8th interstices, placed about the middle, although from the declivity towards the apex they look as if rather behind the middle; the posterior spot smaller, and lying close to the emargination of the apex (which is slight), where several striæ meet, and only separated from the margin by the marginal space; neither of the spots reach the three interstices next the suture; slightly margined; marginal space very narrow, not differing from the other interstices, except in there not being room for any punctuation at all. Under side black, in certain lights iridescent blue. Prosternum and breast coarsely punctate. Abdomen polished, a few coarse punctures near the base. Legs piceous; thighs testaceous, in certain lights bluish iridescent; anterior and intermediate tibiæ partly testaceous; the first three joints of the anterior tarsi very much dilated in the males, and furnished with long spongy squamæ and very long hairs on each side; 1st joint transversely triangular, 2nd and 3rd rounded quadrate, 4th not dilated.

This species is very close to the *Homalolachnus vertagoides* of Laferté, but differs from his description in the following particulars: viz. In my species the head is punctate behind, and there are traces of punctuation near the eyes, while in *vertagoides* the head is said to be smooth (*lisse*). In it, too, the thorax is said to have its greatest breadth at about two-fifths of its length, and the posterior angles are said to form a right angle very slightly obtuse, whilst in my species the greatest breadth is at the middle, and the posterior angles are rounded and something more than "very slightly obtuse." The spots on the elytra do not cover the same interstices, Laferté saying that in his species the anterior spot is separated from the suture by only two interstitial spaces (including in them the sutural space), while in my species it is separated therefrom by three spaces. The colour of the legs also does not quite correspond; the knees are all black in mine, and the middle of the tibiæ of the two anterior pair testaceous, while in *vertagoides* Laferté gives the whole of the thighs as testaceous, and the whole of the tibiæ as blackish.

Chlænius, Bon.

(*Division with yellow spots on the elytra.*)

1. *Ch. oculatus,* Fab.

Ch. Myops, Dej. v. p. 622.
Ch. Chevrolatii, mihi in his Ann. vol. xix. No. 114. tab. 13. fig. 10.

Capite et thorace viridi-æneis, nitidis; thorace angustato, crebre et profunde punctato; elytris obscure cyaneo-viridibus antice, et fere nigris postice, punctato-striatis, interstitiis granulatis et confertissime minute punctatis, macula flava pone medium; subtus niger, pedibus et primis tribus articulis antennarum, palpis atque trophis testaceis.
Long $5\frac{1}{2}$ lin., lat. 2 lin.

Rare. Till corrected by M. de Laferté, I was under the impression that this species was different from the *Ch. oculatus,* Fab., and had attached the name *Ch. Chevrolatii* to it, in honour of my friend M. Chevrolat, in the figure which I published of it in Plate XIII. in the 'Annals' of June last, 1857. The reader is requested to make the following alterations in the names at the bottom of that plate: viz. in place of *Chlænius Chevrolatii* to insert *C. oculatus,* Fab.; and for *Chlænius diaphanicollis* to substitute *Eccoptomenus eximius,* Dej.

(*Division with yellow margins to the elytra, expanded posteriorly.*)

2. *Ch. conformis,* Dej. v. 630.

Capite thoraceque viridi-æneis, nitidis; thorace subquadrato,

antice angustato, transversim rugoso, sparse sed sat profunde punctato; coleoptris obscure viridi-æneis, pubescentibus, striato-punctatis, interstitiis planis subtilissime granulatis, macula communi postica lunata, antice versus marginem leviter recurvata; thoracis margine tenuissime, antennis pedibusque testaceis.

Long. $6\frac{1}{4}$–$6\frac{3}{4}$ lin., lat. $2\frac{1}{2}$–$2\frac{3}{4}$ lin.

(*Division without yellow markings or margins.*)

3. *C. Feronoides*, mihi.

Affinis *Chlænio glabrato*, Dej., parum obesus, supra virescenti-niger, subtus testaceus, nitidus; thorace subquadrato, polito, obsolete sparsim punctato, antice subangustato; elytris striato-punctatis, interstitiis convexis subopacis leviter sparsim punctatis, antennarum basi pedibusque testaceis.

Long. $7\frac{1}{4}$ lin., lat. 3 lin.

Allied to the *Chlænius glabratus*, Dej., and having considerable similarity in general appearance to *Pœcilus cupreus*, Linn., or *Anisodactylus virens*, Dej.

Somewhat obese in form. Above with head and thorax shining, and elytra dull, black; head virescent, and thorax with a slight tinge of virescence, most observable on the margins; elytra almost without virescence, except a slight tinge at the base. Head smooth and shining, slightly punctate, chiefly behind, with an elongate depression on each side in front, and a slight impression in the centre of the forehead; clypeus brown with a virescent reflexion, shining; labrum not emarginate or at any rate scarcely so; the antennæ, labrum (which is dull), mandibles, palpi, and other parts of the mouth rufescent; antennæ with the first joint pale, first three joints shining, the rest pubescent. Thorax subquadrate, narrowest in front, narrowly margined on the sides, which are flatly expanded behind, and are rufescent and semitransparent; base broadly emarginate in the middle; posterior angles broadly rounded and slightly obtuse, anterior angles slightly projecting, dorsal line well marked, but scarcely reaching to the front or base, a deep and well-marked longitudinal fovea on each side of the dorsal line, about midway between it and the posterior angles, and a shallower punctate depression on the inner side of the expanded margin; the surface sparingly but distinctly marked with scattered punctures of various sizes, largest and most frequent along the base and near the dorsal line. Scutellum curvilinearly triangular, rufescent, polished, and with a slight triangular depression in the middle. Elytra glabrous, dull, punctate-striate, the punctures in the striæ delicate, some coarser scattered irre-

gularly (or sometimes with a tendency to a linear arrangement) over the interstices; a few larger impressions on the marginal spaces towards the apex; slightly pubescent towards the sides; the margins and the edges of the suture translucent-rufescent. Under side shining, and scarcely punctate, except on the breast, which is coarsely punctured. Legs testaceous.

Readily distinguished from *Chlænius glabratus*, Dej., by the elytra being black and showing scarcely any indication of virescence, while in *glabratus* they are green and metallic.

4. *Ch. immunitus*, mihi.

Elongatus, politus, nitidus, supra ianthinus, subtus niger; antennis, palpis pedibusque testaceis; thorace angustato, sparsissime punctato; elytris elongatis, depressis, fere glabris, punctato-striatis, interstitiis impunctatis.

Long. 7¾ lin., lat. 3 lin.

Elongate, polished, shining, above of a rich violet-blue, below black; labrum and mandibles ferruginous; antennæ, palpi and legs testaceous. Head smooth and impunctate, except a few scattered punctures running across between the posterior angles of the eyes, and one or two larger punctures before these, alongside the eyes and front of the head; labrum scarcely emarginate. Thorax narrow, with a few distinct punctures scattered very sparingly here and there over the surface, some of them disposed in something like a row on each side of the dorsal line, which is distinct, but reaches neither to the front nor base; margined, a few punctures along the margin; a very deep elongate-impunctate fovea placed on each side somewhat obliquely near the posterior angles, which are obtuse, but scarcely rounded. Scutellum large, black, and impunctate. Elytra glabrous, shining, elongate, depressed, deeply punctate-striate, interstices impunctate; besides the punctures in the bottom of the striæ there is a row of six or ten small punctures along the inner margin of the 3rd and 5th striæ, and also along the interstice next the marginal space, which is granulose, with a row of round, shallow pits with an elevation in the centre; the granulose space becomes widest at the apex, which is very slightly emarginate. Under side polished, prosternum and breast faintly and very sparsely punctured; metasternum more closely punctured; traces of coarse punctuation along the sides of the basal segments of abdomen. Legs testaceous.

This species, in its general outline, has much the general aspect of an *Epomis*, and has also some approach to its generic characters. The palpi are rather more securiform than in most of the *Chlænii*; it has the foveæ on the mentum, which are

suggested by Prof. Lacordaire as possibly a good character by which to distinguish *Epomis* from *Chlænius**; but the palpi are not more securiform than those of some other *Chlænii*, and it wants the yellow margin of the elytra.

5. *Ch. Fairmairei*, mihi.

Capite virescenti et thorace viridi, nitidis; thorace subquadrato, sparsim punctato; elytris obovatis, subconvexis, nigris, punctato-striatis, interstitiis impunctatis; subtus niger; pedibus rufescentibus.

Long. $8\frac{1}{4}$ lin., lat. $3\frac{1}{3}$ lin.

Head virescent with feeble violet reflexions, impunctate or nearly so, faintly wrinkled here and there, chiefly transversely; the usual anterior foveæ effaced, or only visible in particular lights; clypeus virescent, narrowest in front, slightly emarginate, with a puncture near each corner before and behind; labrum distinctly emarginate; antennæ piceous, basal joints paler; remaining parts of mouth piceous; palpi slender; mentum with an elongate deep hollow on each side of the median tooth, but scarcely forming a distinct pit. Thorax subquadrate, narrowed both before and behind nearly equally, broadest about the middle, broadly but not deeply emarginate at the base; posterior angles rounded and obtuse; dorsal line distinct, reaching nearly to the front, but not to the base; green with a bluish tinge; sides margined; smooth, shining, and with a few rather large punctures scattered sparingly and irregularly over the surface; a deep basal longitudinal impression on each side of the dorsal line, extending obliquely outwards and backwards, from the anterior end of which a fainter curved impression extends obliquely outwards and forwards. Scutellum impunctate. Elytra obovate, somewhat convex, except on the disk, which is slightly depressed, black, deeply punctate-striate, the interstices narrowest towards the sides and apex, convex and impunctate; apex slightly emarginate; marginal space granulose towards the apex, with variolose fovea along the space. Under side black; prosternum deeply and coarsely punctate in the centre; pleura or side pieces smooth, with one or two coarse punctures; mesosternum and epipleura thickly punctate, and the abdominal segments pretty thickly punctuate, most so on the sides. Legs obscurely rufescent.

* I fear this character must be renounced as of generic value in this group, as I find several species, which cannot otherwise be separated from *Chlænius*, possessing it, while in others it exists in a greater or less degree. I have observed, however, that wherever it is present in a marked degree, the species have the general aspect of *Epomis*, though they may not have the yellow margins on the elytra, as for instance, the present an several species, from Hong Kong and the East.

I have dedicated this species to my friend M. Léon Fairmaire, President of the Entomological Society of France.

6. *Ch. Waddellii*, mihi.

Capite viridi et thorace virescenti, nitidis; thorace obcordato, sparsim punctato; elytris elongatis, depressis, nigris, vix virescentibus ad basin, punctato-striatis, interstitiis convexis impunctatis; subtus piceus; antennis pedibusque rufescentibus. Long. 12–13 lin., lat. 4½–5 lin.

A large species, about the size and with the general form of *Epomis circumscriptus*.

Head metallic green, sparingly punctured behind, and with two small longitudinal foveæ in front, about which are one or two punctures; a few longitudinal wrinkles along the sides; clypeus of the same colour as the head, with four small foveæ, deepest anteriorly, two in front and one on each side; antennæ rufescent, first three joints shining, the rest pubescent; labrum rufescent, darkest in the middle, not emarginate; mandibles piceous; palpi rufescent, basal joints paler. Thorax obcordate, narrowed behind, broadly emarginate at the base; posterior angles rounded and obtuse; dorsal line distinct, reaching to the base, or nearly so, but not in front beyond the semicircular line, black, slightly virescent on the back, but bright metallic bluish-green on the anterior angles and sides, which are margined; smooth, shining, and with a few rather large punctures scattered sparingly and irregularly over the surface, a little more frequently towards the base; a deep, impunctate, longitudinal fovea is placed a little in advance of the base on each side of the dorsal line, but nearer to the external margin than to the latter. Scutellum subsinuate-triangular, impunctate, with a slight depression on each side towards the base. Elytra glabrous, long, broad and depressed, black, with a very slight bluish-green tinge at the base and margins, punctate-striate, the striæ deep, but the punctures in them rather faint and transverse; the interstices convex and impunctate; the marginal space pubescent, finely punctate, with a few larger depressions; remains of pubescence are also seen springing from the punctures in the striæ; the apex is only slightly emarginate. Under side piceous; prosternum smooth, with a few scattered punctures on the sides; mesosternum more so, and metasternum, epipleura, and abdominal segments with a fine granular or papillose punctuation, most marked on the sides. Legs rufescent, with the knees and tarsi somewhat darker.

I have named this fine species (the largest of the *Chlænii* which I have received from Old Calabar) after the Rev. Hope

M. Waddell, one of the most zealous and able of the missionaries who have done so much both for natural science, civilization and religion in this interesting region.

Dilobochilus, Laferté, Ann. Soc. Ent. France, (2 sér.) ix. 293.

1. *D. Westermanni,* Laf. Rev. et Mag. d. Zool. 1852, p. 67.

Tomochilus Westermanni, Laf. *loc. cit.*

Capite thoraceque viridi-æneis, nitidis; thorace subquadrato, antice angustiore, sparse et sat profunde punctato, ad basin utrinque foveis profundis longitudinaliter impresso; marginibus rubro-cupreo micantibus; elytris nigris et opacis, striato-punctatis; interstitiis parum elevatis, geminato-punctatis, alternis aureo-cupreo micantibus, margine viridi-cupreo splendente; subtus niger; antennarum basi, palpis, ore et pedibus testaceis.

Long. 7½ lin., lat. 3 lin.

This beautiful insect, when in good preservation, is readily recognized by the alternate interstices shining with a metallic lustre. It, however, sometimes arrives in a rubbed or greasy state, when the metallic lustre is almost entirely effaced from the interstices.

Eccoptomenus, Chaud. Bull. Mosc. 1850, No. 2. p. 409.

Hoplogenius, Laf. Ann. Soc. Ent. Fr. (2 sér.) ix. p. 237.
Chlænius, Bon. Dej.

1. *E. eximius,* Dej. v. p. 612.

Chlænius diaphanicollis, mihi in his Ann. vol. 19. No. 114. tab. 13. fig. 11.

Capite æneo-virescenti, vix punctulato, mandibulis ferrugineis, labro et clypeo, palpis et primis duobus articulis antennarum testaceis; thorace parum circulari, antice emarginato, postice truncato, pubescenti, confertissime leviter punctato, ferrugineo-flavo, postice et in medio fuscescenti; lateribus reflexis ut in *Agono,* translucentibus; elytris latis, subdepressis, leviter punctato-striatis, obscure nigris, cum margine, macula humerali, macula transversa fere ad medium, et macula communi cordiformi ad apicem positis, omnibus junctis ad lineam marginalem, ferrugineo-flavis; interstitiis non punctatis sed leviter et irregulariter transverse aciculatis; subtus niger, cyaneo-iridescens; prosterno lateribus testaceis; pedibus testaceis.

Long. 8 lin., lat. 3¼ lin.

I had figured this species under the name *Chlænius diaphanicollis* in the Plate above referred to which, accompanied a pre-

vious part of this list, published in the Number of the Annals for June, 1857. Since then I learn from M. de la Ferté, who possesses the original specimens which belonged to the Count Dejean, that it is identical with the *Chlænius eximius* of that author, to which I have accordingly restored it.

My specimens, however, seem to differ somewhat from the normal type of Dejean. In his the thorax is darker in the middle, while in mine a blackish tint invades both the middle and the base. The yellow markings on the elytra also are not confined to the interstitial spaces specified by Dejean; but as I find my examples to vary in this respect, some having the markings more expanded than others, it is obvious that such differences are not specific.

[To be continued.]

BIBLIOGRAPHICAL NOTICE.

Elements of Entomology. By W. S. Dallas, F.L.S. London: Van Voorst. 1857. 12mo.

"Amongst the numerous works published on Entomology, it appeared to the author that there was none which gave, in a popular and readable form, an outline of the principal groups into which Insects are usually divided. It was with the object of filling up this gap in our Entomological literature, that the present little book was written." Such is the opening sentence of the volume now before us; and we believe that it will be generally admitted that the *hiatus* to which it refers has been satisfactorily filled up. In some respects, however, we would have gladly seen a still more elementary tone throughout this excellent work, for the minds of beginners, for whom it has been peculiarly compiled, can only take in knowledge by homœopathic doses, and are apt to "go off at a tangent" where the details, however carefully selected, are too minutely dwelt upon; and the subject-matter has been already so well and ably handled, in a scientific point of view, by Mr. Westwood, in his admirable 'Introduction to the Modern Classification of Insects,' that the want which has been especially felt by our tyros, at the commencement of their entomological career, is, not an elaborate essay, but a treatise of so brief and rudimentary a character as shall at once put them in possession, *in proper order,* of those primary facts and definitions (unaccompanied by more particulars than what are absolutely necessary) which form as it were the merest groundwork and alphabet of their science. Mr. Dallas has, however, taken a somewhat higher standard in the volume which he has just given us; and we can only say, that, provided his "incipients" *have sufficient patience* to follow him throughout the 424 interesting pages which he has prepared for their instruction, they will have no cause, unless indeed we are much mistaken, to quarrel with their teacher.

Mr. Dallas commences his volume with the definition of an Insect ("our bill of fare will consist exclusively of Insects; but what is an Insect?"); and then alludes to the main features which separate the *Insecta* proper from the three allied divisions of *Myriapoda*, *Arachnida* and *Crustacea*. In the second chapter he discusses the "Structure of Insects in general," pointing out the particular adaptation (of one, common type) which characterizes each successive Order. That portion which refers to the several modifications of the parts of the mouth is particularly lucid. It is satisfactory also to see that Mr. Dallas is alive to those higher deductions from his subject in which the doctrine of Final Causes in Creation takes its rise, and which some of our *quasi*-'philosophers' have of late thought it their special mission to sneer at. "Few things," says he, "could furnish the natural theologian with a better proof of design in nature than the investigation of the course adopted in the modification of the same parts, which we have just seen in the form of powerful biting organs, to constitute the agents of a suctorial existence; nor is our admiration in any degree lessened by the consideration that many of the creatures in which these phænomena are to be witnessed are so small as almost to elude the naked eye,—for, in the words of the late Professor Forbes, 'wonders are not the less wonderful for being packed into a small compass.'"

Chapter III. treats (first) of the sexes, and (secondly) of the transformations of Insects,—both of which are ably and clearly handled. As a favourable specimen of Mr. Dallas's style, we may quote the following, concerning the latter of these:—

"We meet with few more remarkable phænomena, in the history of animal life, than this of the metamorphosis of insects. When we think that the same animal is at one period of its existence a crawling, worm-like creature, devouring with the greatest voracity large quantities of coarse food, and then, after passing a longer or shorter period in a state of comparative inaction, inert and apparently almost dead, makes its appearance as a butterfly, one of the most elegant and aërial of beings, passing its whole existence in sporting in the sun's rays, and deriving its sole nourishment from the delicate fluids of flowers, it is impossible to restrain our admiration; and although modern science may have stripped the phænomenon of much of the marvellous which invested it with a greater glow of wonder in former ages, it must be confessed that it has at the same time opened up to us a source of more rational admiration by teaching us, that, whatever may be the apparent discrepancies between them, *the same elements, nay, even the same parts, are present in the one as in the other*, and that by this means one and the same animal is fitted for the performance of two totally distinct duties in the grand œconomy of nature" (p. 46).

Immeasurably the best portion of the book, however, as it appears to us, is the short chapter on "Classification and Nomenclature" (Chap. IV.), which is alike sound and philosophical; though we doubt whether the definition of a "species," however true, will be sufficient to satisfy at any rate a certain section, happily not a very

extensive one, of our modern speculators: "The root of all classification in natural history is formed by the *species*,—which may be roughly defined as an assemblage of individuals all possessing exactly the same characters, and which are all supposed to have originated from the same parents. The systematic naturalist therefore takes no notice of the individual, which in his eyes is merely an example of the species to which it belongs; and the latter thus forms as it were the first step towards a classification" (p. 51).

Speaking also of the binomial method of nomenclature, Mr. Dallas has the following very appropriate remark: "This system is the same in principle with our own constant practice in common parlance, when we employ a well-known substantive in a generic sense, and qualify it to suit particular cases by the addition of an adjective."

As regards the classification followed, the author has not departed substantially from that which has been employed by Mr. Westwood and most British entomologists; nevertheless he expresses his conviction that "the adoption of the metamorphosis as the foundation of the arrangement of Insects leads to a more philosophical result." Without wishing, however, to undervalue the importance of the transformations in guiding us to a natural classification in the insect world, we must plead guilty, for our own part, to a certain *à priori* prejudice in favour of both metamorphosis and *ultimate structure* being taken into account, whilst endeavouring to arrive at the truth; for we cannot believe that *either* of them, alone, will ever lead to a sufficient appreciation of the several creatures (both in their constitutions and attributes) to enable us to arrange them in real accordance with nature. And we need scarcely add, therefore, that we prefer the system which Mr. Dallas has adopted to that (*vide* p. 58) to which he affirms his own adherence,—founded exclusively on the character of the transformations.

The remaining twelve chapters, forming the larger portion of the work, are devoted to the description of the seven great Orders into which the *Insecta* are divided. We say "seven," because we cannot regard the *Strepsiptera* as more than retained provisionally separate from the *Coleoptera* (to which it clearly belongs—a fact which Mr. Dallas himself seems inclined to admit), the *Physopoda* from the *Neuroptera*, and the Fleas from the *Diptera*. In these chapters the various Orders are ably discussed *seriatim*,—the *Rhynchota* (as might be anticipated from the author's well-known predilection for the Bugs) being more particularly fortunate perhaps in their mode of treatment. The following is an example of Mr. Dallas's happy manner of depicting, what must be to most of us, a familiar friend:—

"Every one must have remarked, especially during the early part of the summer, the occurrence, upon many plants and shrubs in our gardens, of curious little masses of froth, generally known to gardeners under the name of 'Cuckoo-spits,' from a very ancient idea that that singular bird the Cuckoo was in some way connected with their production. On examining some of these Cuckoo-spits, however, we soon discover the real cause of their formation in the shape of a small, yellow, soft insect, with brown eyes, which seem to stare

at us in a glassy, expressionless manner, worthy of the ghastly shipmates of Coleridge's 'Ancient Mariner.' Nevertheless, the general appearance of the insect is rather sprightly than otherwise, although the absence of wings, and some other peculiarities, show it to be in the larva or pupa state, and the frothy matter with which it is surrounded, and which consists of an excrementitious fluid, is evidently intended to protect its soft body from the attacks of its enemies" (pp. 411, 412).

Although of minor importance, there are one or two points which we might suggest as capable of improvement, should a second edition ever be called for. Thus, the advantage of having at the head of each of the several divisions of the chapters *the name of the family, or tribe*, which is about to be treated of, would have been very considerable; for, owing to the light, and often amusing, style in which the volume is written, one frequently has to read through as much as a page and a half before becoming aware what the family really is which is under discussion. This is a serious impediment to a beginner,—who requires to have his attention prepared *ab initio* for the several divisions as they occur; and (which is very desirable), moreover, *his eye tutored to the names.* An epitome, also, of the subdivisions, if given at the commencement of each Order, would have been a great help to the tyro, in enabling him to discern his path beforehand, and, as it were, to *picture* it in his imagination.

These suggestions, however, are perhaps needless; for such additions can, after all, be made by the reader himself without much trouble. In everything essential the book is excellent, and will prove a useful guide for the entomological student,—to whose careful perusal we would, therefore, heartily commend it.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 14, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

On Stoastomidæ as a Family, and on Seven proposed New Genera, Sixty-one New Species, and Two New Varieties from Jamaica. By the Hon. Edward Chitty.

[Continued from page 79.]

Genus III. Fadyenia, Chitty.

Spire depressed, subangular on the upper part of the last whorl, subplanulate at the periphery, subangulate below, and subplanulate round the umbilicus.

Fadyenia Fadyeniana. See *Stoastoma Fadyenianum*, Ad. Mon. Stoast. Adams, 1849, p. 7; Cat. Phan. p. 231.

Hab. Hills S.W. of Port Henderson.

Other shells, I have reason to know, have been distributed for this.

Fadyenia Bowerbankiana, Chitty.

Hab. Roaring River, Westmoreland.

Form, subdiscoidal. *Colour,* very pale tinge of brown. *Sculpture,* 24 strong equidistant (above) spiral carinæ, wider apart below, more faint round the umbilicus, and obsolete at the labrum; with a hiatus between the 13th and 14th, equal to the space occupied by 3 carinæ, at the periphery; 7 visible on the upper whorls. *Spire,* much depressed with concave outlines. *Apex,* mamillated. *Whorls,* 4, well rounded above, with a deep suture; last whorl rather large and expanded; subangular at the upper part, subplanulate at the periphery, and subangular below, subplanulate, but more convex round the umbilicus than in *F. Fadyeniana*; the whorl is much wider above than below, so that the subplanulate periphery is nearly at right angles with the outline of the spire. It is the same in *F. Fadyeniana.* *Aperture,* very slightly constricted above behind the labrum; dilated, large; rather more constricted below, behind, and at the labrum; upper third flattened almost at a right angle with the labium; well rounded below. *Labrum,* simple, white. *Labium,* on a plane with the labrum, well detached from the body-whorl; thickened and reflected towards the umbilicus, more so below than above; much rounded to the right below. *Umbilicus,* rather deep. *Labral lamella,* well defined, strong and prominent, and inflected upwards towards the umbilicus. *Operculum* —— ?

Height 0·041, greatest breadth 0·08, least breadth 0·063.

Named in compliment to my friend and fellow-labourer in science, Dr. L. Q. Bowerbank, M.D., of Kingston, Jamaica.

Note.—In *F. Fadyeniana* fine spiral carinæ intervene between the coarser, and all are more distantly apart.

Fadyenia Grayana, Chitty.

Hab. Yallahs Hill.

Form, subdiscoidal. *Colour,* rich light brown. *Sculpture,* about 33 irregular and inequidistant, some fine and some rather strong, spiral carinæ, of which 8 or 9 are visible on the upper whorls. *Spire,* much depressed, less than in *F. Bowerbankiana,* with concave outlines. *Apex,* mamillated. *Whorls,* 4⅔rds, with a moderate suture; last whorl typical, subangulated and subplanulated as in *F. Bowerbankiana* and *F. Fadyeniana.* *Aperture,* semicircular, only slightly affected by the subangularity above and below the periphery, very slightly dilated. *Labrum,* double; outer edge pectinated by the spiral carinæ, inner edge simple, white and shining. *Labium,* white, thickened and reflected towards the umbilicus about its centre, below much curved to the right, much lower than the plane of the labrum at its lower end; widely separated from the body-whorl. *Umbilicus,* very deep and narrow. *Labral lamella* very broadly and sharply produced throughout; besides the labral lamella within the umbilicus, extending from the back of the labium to the umbilicus and body-whorl, are four or five well-produced distinct sharp lamellæ. *Operculum,* deeply concave in the centre, with a broad margin all

round, which, on that side, folds well over the labrum, especially below; much covered by numerous coarse granulations, and in the hollow on the labral side with four or more strong raised lamellæ, which are also covered with coarse granulations.

Height 0·076, greatest breadth 0·105, least breadth 0·087.

Named in compliment to Dr. J. E. Gray, British Museum.

Genus IV. Stoastoma, Adams.

Shell subglobose.

Stoastoma pisum, Ad. See Mon. Stoast. Adams, 1849, p. 11; Cat. Phan. p. 228.

Sculpture, almost obsolete, very numerous raised spiral microscopic carinæ, which are well defined on the upper whorls, four or five being visible. *Labrum,* double. *Labium,* well detached from the penult whorl. *Operculum,* concave and finely granulated in its concavity.

Hab. Manchester, generally, and near Accompong Town, St. Elizabeth.—*Chitty.*

Stoastoma Pfeifferianum, Ad. See Mon. Stoast. Adams, p. 8; Cat. Phan. p. 230.

Labrum, double. *Operculum,* concave, finely granulated in its concavity; margin sharp on the labral side, rather broad, but not thickened on the labial side.

Hab. Manchester back woods.—*Chitty.*

Stoastoma Livesayanum, Chitty.

Hab. Near Ashley Hall, Trelawny.

Form, subglobose. *Colour,* pale yellow. *Sculpture,* 11 distant, blunt and raised spiral carinæ, of which 5 are visible on the upper whorls. *Spire,* conic, moderately elevated, with slightly convex outlines. *Whorls,* 4⅔rds, scarcely rounded, with a very slight suture. *Aperture,* very slightly expanded; semielliptical, widest in the upper third of the labrum, very oblique. *Labrum,* pectinated by the spiral carinæ; double, very slightly reflected. *Labium,* slightly below the plane of the labrum, well detached from penult whorl, but connected with it by five or six of the spiral carinæ; arcuated to the left above into a sharp angle with the labrum, very much curved below to the right. *Umbilicus,* very small and deep. *Labral lamella,* strongly produced above, but immediately lost in the umbilicus. *Operculum,* semielliptical, planular, with fine granulations on the labral side, and concave on the labial side, with a raised ridge all round, which is much thickened and rounded, and highly raised about the lower part of the labral side.

Height 0·081, greatest breadth 0·103, least breadth 0·08.

Named in compliment to my friend Dr. Livesay, a devoted collector of genera.

Stoastoma, or Electrina, succineum, Sowerby, will belong to this group. See Cat. Phan. p. 228.

Genus V. Metcalfeia, Chitty.

Shell, depressed conic.

Metcalfeia Chittyana, Chitty. See *Stoastoma Chittyanum,* Ad. Mon. Stoast. Ad. 1849, p. 10; Cat. Phan. p. 231.

Hab. Peace River, Manchester.

Operculum, very slightly concave, with two strong lamellæ crossing its centre horizontally, and on the labial side two much finer ones above, and three or four below.

Metcalfeia Metcalfeiana, Chitty.

Hab. ——? Hanover.

Form, depressed conic. *Colour,* pale horn. *Sculpture,* lines of growth visible; sixteen strong, but not much raised inequidistant spiral carinæ, those round the umbilicus being most prominent, with here and there one very fine carina intervening. On the upper whorl, 5 carinæ. *Spire,* moderately elevated with very slightly concave outlines. *Apex,* obtuse. *Whorls,* 4½, very moderately convex, with a slightly impressed suture. *Aperture,* subsemicircular, slightly spreading. *Labrum,* subangularly produced from the body-whorl, not abruptly produced, deeply pectinated by the spiral carinæ. *Labium,* slightly detached from the body-whorl, very slightly curved below to the right; much below the plane of the labrum. *Umbilicus,* very deep and narrow. *Labral lamella,* very little, but sharply, produced, not concealing the umbilicus. *Operculum,* slightly concave, finely granulated in the hollow with three strong, apparently not serrated, horizontal lamellæ, extending from the labral side over two-thirds of the width of the operculum, and one equally strong between the first and second above extending one-third across only, the lowest slightly curved downwards.

Height 0·073, greatest breadth 0·096, least breadth 0·079.

Named in compliment to W. Metcalfe, Esq., the possessor of a fine cabinet of shells.

Metcalfeia Baquiéana, Chitty.

Hab. Near "The Cave," high road, Westmoreland.

Form, depressed conic. *Colour,* rich brown, fading into faint yellow and white. *Sculpture,* 19 spiral carinæ, with one fine intervening between each pair. On the upper whorls 6 carinæ. *Spire,* moderately and rather concavely elevated. *Whorls,* 4½, slightly rounded with a slightly impressed suture. *Aperture,* slightly expanded, shortly and roundly produced from the penult whorl, scarcely depressed; subsemicircular, rather dilated above. *Labrum,* pectinated by all the stronger carinæ, slightly scolloped. *Labium,* slightly detached from the penult whorl, rather abruptly detached from the labrum above and curved below to the right, much lower than the plane of the labrum below. *Umbilicus,* not deep. *Labral lamella,* expanded above, narrow round the umbilicus. *Operculum,* concave in the middle, seven lamellæ radiating horizontally from the labial side, one

short and central above, one (the longest) crossing the hollow, one short on the labral side, one longer (second in length), one short, and two longer (third in length) below.

Height 0·06, greatest breadth 0·089, least breadth 0·071.

Named in compliment to my friend, Mons. Baquié, of Westmoreland, Jamaica.

This shell is closely allied to *Metcalfeia Chittyana* at first glance, but differs in many minute particulars; the pectination on the labrum is alone sufficient to distinguish it; and their habitats are about sixty miles asunder. The spire is more conical than in *M. Chittyana*, spiral carinæ more distant, labium less widely detached from penult whorl, upper part of labrum more produced, apex more blunt. In *M. Chittyana* the labral lamella expands suddenly above close to where it leaves the labium, rising above the plane of the aperture, and then descending round the umbilicus in a uniform curve without projecting; in *M. Baquiéana* it does not rise above the plane; but after leaving the labium, it spreads out towards the centre of the umbilicus, and continues uniform till it is lost in the umbilicus. In the former the lower end of the labium is on a plane with the labrum, in this it is below the plane. In this, the aperture is larger and more oblique, and the last whorl is less expanded.

METCALFEIA SUTHERLANDIANA, Chitty.

Hab. Belmont, St. James.

Form, depressed conic. *Colour*, very pale horn or white. *Sculpture*, lines of growth visible; 19 rather strong, inequidistant, spiral carinæ, with an unequal number of finer ones intervening. On the upper whorls 5 carinæ. *Spire*, moderately and rather concavely elevated. *Whorls*, 5, moderately elevated, with a deep suture. *Aperture*, less than a semicircle, slightly expanded in the lower two-thirds, slightly oblique. *Labrum*, unequally and not strongly pectinated by the spiral carinæ, very slightly produced above. *Labium*, well detached from the body-whorl, attached to labrum above in a slight curve, very slightly waved in its centre, and well curved to the right below. *Umbilicus*, moderately deep, and labral lamella moderately produced. *Operculum*, —— ?

Height 0·072, greatest breadth 0·12, least breadth 0·079.

Named in compliment to Dr. P. Sutherland, the Arctic voyager, now Government Surveyor of Port Natal.

METCALFEIA MÖRCHIANA, Chitty.

Hab. Roaring River, Westmoreland.

Form, depressed conic. *Colour*, very pale horn. *Sculpture*, 5 strong spiral carinæ, 1 fine; 7th strong and 3 fine; 8th to 15th strong and 1 fine intervening between each pair; on the upper whorls 8 strong. *Spire*, slightly elevated, with concave outlines. *Whorls*, $4\frac{3}{4}$, very slightly rounded with a slight suture. *Aperture*, slightly expanded, more below than above; slightly produced abruptly from the penult whorl: more than a semicircle. *Labrum*, thin, and very

slightly reflected; pectinated by the strong carinæ. *Labium,* on a plane with the labrum above, lower below; joining the labrum with a curve above; much curved to the right, below well detached from the penult whorl. *Umbilicus,* narrow and deep. *Labral lamella,* well produced above and rather wide below. *Operculum,* moderately concave in the middle, with a wide border on the labial side, which is vertically grooved and again crossed by four or five raised horizontal plaits: labral side with about eight short horizontal lamellæ, about four extending across the hollow, and a linguiform point at the lower extremity of the labial side overlapping the labium.

Height 0·072, greatest breadth 0·1, least breadth 0·074.

Named in compliment to M. Mörch, of Copenhagen, distinguished for his knowledge of Mollusca.

Metcalfeia Verreauxiana, Chitty.

Hab. —— ? Hanover.

Form, depressed conic. *Colour,* pale horn or yellow. *Sculpture,* 17 strong spiral carinæ with 1 fine intervening between each pair. On the upper whorls 5 strong with 1 fine intervening. *Spire,* moderately elevated, with straight outlines. *Whorls,* $4\frac{1}{3}$, moderately rounded, with a light suture. *Aperture,* scarcely separated from the body-whorl, more than a semicircle, large, rather expanded and depressed below. *Labrum,* very slightly produced above, strongly and prominently pectinated by the strong carinæ, imbricated in those round the periphery, white and shining. *Labium,* slightly rounded into the labrum above, and on the right below; very slightly reflected; on a plane with the labrum above, lower below; very slightly detached from the body-whorl. *Umbilicus,* deep and narrow. *Labral lamella,* sharp and very slightly produced. *Operculum,* moderately concave, with large coarse granulations on the upper part of the labial side, slightly lamellated horizontally; lower portion of labial side broad and spreading over the labium, with a deep groove, and terminating with a broad uplifted linguiform plait, which is distinct from the spreading upper portion.

Height 0·06, greatest breadth 0·078, least breadth 0·06.

Named in compliment to M. Verreaux, an experienced zoological collector.

Metcalfeia Sinclairiana, Chitty.

Hab. Maroon Town, St. James (unique).

Form, depressed conic. *Colour,* pale horn or yellow. *Sculpture,* 9 strong spiral carinæ, with one fine intervening; on the upper whorls, 3 strong and fine ones intervening. *Spire,* slightly elevated, with rather concave outlines. *Apex,* rather acute. *Whorls,* $4\frac{1}{4}$, moderately rounded, with a slight suture. *Aperture,* slightly spreading about the periphery to below; subsemicircular. *Labrum,* very slightly produced above, more so below; broadly detached from the body-whorl, strongly pectinated by the spiral carinæ. *Labium,* well detached from the body-whorl, on a plane with the labrum above, lower below, slightly curved to the right above, much so below, much

thickened. *Umbilicus,* narrow and deep, well covered by the *labral lamella. Operculum,* ——?

Height 0·057, greatest breadth 0·084, least breadth 0·067.

Named in compliment to Dr. Andrew Sinclair, R.N., late Colonial Secretary of New Zealand.

Metcalfeia Mitchelliana, Chitty.

Hab. Maroon Town, St. James (unique).

Form, depressed conic. *Colour,* pale horn. *Sculpture,* 15 strong spiral carinæ, rather inequidistant, with one very fine intervening, and about the periphery sometimes two and sometimes three fine carinæ: at the periphery the two strong carinæ are widest apart, with three fine intervening; the next division below has one fine only, and the next below, two; on the upper whorls four strong carinæ. *Spire,* slightly elevated, with rather concave outlines. *Whorls,* 4½, slightly rounded, with a moderate suture; last whorl expanded above and falling away below. *Aperture,* semicircular, much dilated below the periphery. *Labrum,* very slightly pectinated by the strong carina, very slightly produced above. *Labium,* on a plane with the labrum above, much lower below; slightly curved to the right below, moderately detached from the body-whorl. *Umbilicus,* deep, little affected by the labral lamella. *Operculum,* ——?

Height 0·07, greatest breadth 0·095, least breadth 0·077.

Named in compliment to D. W. Mitchell, Esq., the energetic Secretary of the Zoological Society of London.

Metcalfeia Dohrniana, Chitty.

Hab. Pedro District, St. Ann's.

Form, depressed conic. *Colour,* pale horn. *Sculpture,* 4 strong spiral carinæ and 1 fine, 1 strong and 1 fine, 1 strong and 3 fine, 1 strong and 2 fine, and 1 strong and 3 fine, 1 strong, then 8 strong with fine intervening; on the upper whorls, 5 spiral carinæ. *Spire,* slightly elevated, with concave outlines. *Whorls,* 4, very slightly rounded with a moderate suture. *Aperture,* more than a semicircle, moderately expanded, very oblique. *Labrum,* moderately produced above, reflected, much pectinated by the strong spiral carinæ. *Labium,* well detached from the body whorl, curved to the right below, straight above, almost on a plane with the labrum. *Umbilicus,* deep and moderately broad. *Labral lamella,* strong, sharp and expanding, with a projecting angular point a little below its junction with the labrum. *Operculum,* ——?

Height 0·052, greatest breadth 0·079, least breadth 0·061.

Named in compliment to Herr Heinrich Dohrn, of Stettin, a zealous young conchologist.

Metcalfeia Layardiana, Chitty.

Hab. ——? Westmoreland.

Form, depressed conic. *Colour,* rich light brown. *Sculpture,* about 25 and slightly unequally raised, inequidistant spiral carinæ; on the upper whorls 6 or 7. *Spire,* moderately elevated, with rathe

concave outlines. *Whorls,* 4¼, moderately rounded, with a moderate suture; last whorl well rounded. *Aperture,* moderately oblique, very moderately expanded and slightly deflected below, semicircular. *Labrum,* slightly produced above in a curved line, pectinated by about 15 of the spiral carinæ. *Labium,* moderately detached from the body-whorl, rather serpentine above and much curved to the right below. *Umbilicus,* deep and narrow. *Labral lamella,* but slightly expanded. *Operculum,* slightly concave, with about six horizontal raised lamellæ, nearly parallel above, but converging towards the umbilicus below, strong on the labial side, and faintly crossing over the labial side and covering the labium, with, on that side, others intervening.

Height 0·062, greatest breadth 0·086, least breadth 0·069.

Named in compliment to E. L. Layard, Esq., late of Ceylon, now Curator of the Museum, Cape Town, Cape of Good Hope.

Metcalfeia Swiftiana, Chitty.

Hab. Near Mr. Channer's, Santa Cruz Park, Saint Elizabeth (unique).

Form, depressed conic. *Colour,* pale horn, light brown at apex. *Sculpture,* 28 irregularly strong and inequidistant spiral carinæ; on the upper whorls 6. *Spire,* moderately elevated, with slightly concave outlines. *Whorls,* 4½, moderately rounded, with a deep suture; last rather large. *Aperture,* slightly constricted and very slightly expanded at its margin; semicircular; slightly depressed above and slightly expanded below. *Labrum,* very slightly produced above; very slightly pectinated externally by, more or less, all the carinæ; smooth and white and shining at its extreme margin. *Labium,* well detached from body-whorl, on a plane with the labrum; much curved to the right below and reflected to the left. *Umbilicus,* deep and narrow. *Labral lamella,* widely spreading. *Operculum,* —— ?

Height 0·059, greatest breadth 0·087, least breadth 0·069.

Named in compliment to Robert Swift, Esq., of the Island of St. Thomas, an ardent collector.

Genus VI. Petitia, Chitty.

Shell, globose discoid.

Petitia Petitiana, Chitty. See *Stoastoma Petitianum,* Ad. Ann. Lyc. New York, v. n. 2. p. 67; Contr. Conch. p. 151; Cat. Phan. p. 232.

Hab. Peace River, Manchester.

Petitia Cumingiana, Chitty. See *Stoastoma Cumingianum,* Ad. Mon. Stoast. Ad. 1849, p. 9; Cat. Phan. p. 231.

Hab. —— ? Manchester.

Note.—If I have the right type of this shell, the *operculum,* in addition to the "numerous lamellar grains" described by Adams,

has 6 or 7 very slightly raised vertical lamellæ curving from above to the left below, with an inner raised margin inclosing the concavity and sloping outwards to the extreme edge of the operculum.—*Chitty.*

PETITIA ANTHONIANA, Chitty. See *Stoastoma Anthonianum,* Ad. Contr. Conch. p. 151; Cat. Phan. p. 232.

Hab. ——? Manchester.

PETITIA STEVENSIANA, Chitty.

Hab. Yallahs Hill.

Form, globose-discoid. *Colour,* very light brown. *Sculpture,* 23 well-raised, inequidistant spiral carinæ, wider apart below round the umbilicus; on the upper whorls 7. *Spire,* slightly elevated, with convex outlines. *Whorls,* 4, well rounded, with a deep suture. *Aperture,* subelliptical, well detached from the body-whorl; slightly constricted and scarcely expanded, and but little deflected below. *Labrum,* double, outer edge very finely pectinated by the spiral carinæ; inner edge white, smooth, slightly thickened and reflected; continuous with the labium above, with a slight curve. *Labium,* almost straight, very slightly curved to the right below, where it is below the plane of the labrum. *Umbilicus,* deep. *Labral lamella,* produced to a saw-like tooth at some little distance below its junction with the labium; convex externally. *Operculum,* ——?

Height 0·047, greatest breadth 0·086, least breadth 0·065.

Named in compliment to S. Stevens, Esq., Bloomsbury Street, London.

PETITIA FORTUNEANA, Chitty.

Hab. ——? Manchester.

Form, globose-discoid. *Colour,* very pale horn. *Sculpture,* 25 spiral carinæ, about 8 on the upper whorls. *Spire,* much depressed, with convex outlines. *Whorls,* 4, moderately rounded, with a slight suture. *Aperture,* constricted at about the width of the last whorl from the labrum, and then expanded considerably at about an angle of 30°, expanded above and deflected slightly below; more than a semicircle. *Labrum,* slightly double, especially above and below, less so at the periphery; inner edge smooth, white and shining, broadly but slightly scolloped and finely pectinated by about 5 points; joined and rounded into the labium above; much produced angularly and deflected above; produced from the body-whorl at an angle of about 60°. *Labium,* straight, with a slight curve to the right below; on a plane with the labrum above, and slightly lower below. *Umbilicus,* very deep. *Labral lamella,* very sharp and narrow, not covering the umbilicus. *Operculum,* slightly concave, with apparently obsolete bars crossing it horizontally.

Height 0·043, greatest breadth 0·078, least breadth 0·061.

Named in compliment to Robert Fortune, Esq., the celebrated Chinese traveller and collector.

Petitia Adamsiana, Chitty.

Hab. New Hope, Old Hope, and a smaller variety on the road east of the "Water-wheel," Westmoreland.

Form, globose-discoidal. *Colour,* reddish horn. *Sculpture,* 13 very strong spiral carinæ, with between the 1st and 2nd and 2nd and 3rd, 1 each rather less strong; between the 3rd and 4th and 4th and 5th, 3 each less strong; between the 5th and 6th, 1 less strong; between the 6th and 7th, 3 less strong; between the 7th and 8th, 1 less strong, and none between the remaining strong carinæ. Lines of growth very faint; on the upper whorls, 4 strong carinæ with intervening less strong. *Spire,* slightly elevated, with rather convex outlines. *Whorls,* 4½, very slightly rounded and with a very slight suture; last whorl slightly swelling behind the labrum, and slightly constricted at the aperture. *Aperture,* very slightly expanded and scarcely detached from the penult whorl. *Labrum,* appressed to the body-whorl, not produced much thickened, slightly double below; smooth and simple. *Labium,* much thickened and reflected towards the umbilicus in its centre, slightly curved to the right below; well detached from the body-whorl. *Umbilicus,* moderately deep, covered by an expansion very convex externally of the *labral lamella,* which is much produced immediately after leaving the labrum, and then becomes abruptly narrowed till it joins the body-whorl. In the labral lamella it approaches the subgenus *Agassizia. Operculum, very peculiar,* deeply concave in the centre and studded with very fine granulations; edge all round very much thickened and folded over in vertical plaits outside, especially at the lower end of the labial side; throughout the labial side overlapping the labium with sharp, fine, numerous raised lamellæ on the labral side.

Height 0·062, greatest breadth 0·09, least breadth 0·077.

Var. *a.*

From near "Water Wheel."

Height 0·044, greatest breadth 0·076, least breadth 0·061.

Named in honour to the memory of the late Professor C. B. Adams of America, my friend and conchological master.

Petitia Tayloriana, Chitty.

Hab. ——? St. Ann's.

Form, globose-discoid. *Colour,* pale horn. *Sculpture,* 24 fine, sharp, inequidistant, spiral carinæ, 6 of which interspersed are rather strong; on the upper whorls 5. *Spire,* very slightly elevated, with convex outlines. *Whorls,* 4, slightly rounded, with a slight suture. *Aperture,* very slightly constricted behind the labrum, and slightly expanding; scarcely detached from the body-whorl; slightly depressed above and expanded below. *Labrum,* white, shortly reflected, not produced above, very little pectinated by the stronger spiral carinæ; slightly double below. *Labium,* on a plane with labrum, straight, appressed above to the body-whorl. *Umbilicus,* rather deep and narrow. *Labral lamella,* scarcely produced. *Operculum,*

slightly concave, rather produced at the upper corner of the labial side; smooth, but not shining.

Height 0·033, greatest breadth 0·06, least breadth 0·043.

Named in compliment to T. L. Taylor, Esq., the possessor of a fine collection of shells.

Petitia Stricklandiana, Chitty.

Hab. Roaring River, Westmoreland.

Form, globose-discoid. *Colour,* rich red-brown. *Sculpture,* lines of growth apparent; 38 inequidistant, irregularly raised, very fine spiral carinæ; on the upper whorls 8. *Spire,* very little elevated, with convex outlines. *Whorls,* $3\frac{2}{3}$rds, well rounded, with a deep suture. *Aperture,* widely dilated, not constricted, more dilated and depressed below; very slightly detached from body-whorl. *Labrum,* very widely double, moderately produced above, inner and outer edge strongly 'pectinated' and scolloped by 6 points of the spiral carinæ. *Labium,* very little detached from body-whorl, straight above and abruptly curved below to the right; much below the plane of the labrum. *Umbilicus,* deep and rather broad. *Labral lamella,* very little produced. *Operculum,* slightly concave, with fine granulations in the hollow; labral margin with two sharp raised lamellæ round it; a small narrow linguiform point overlapping the labium at the lowest extremity on the labial side.

Height 0·049, greatest breadth 0·074, least breadth 0·055.

Named in compliment to H. E. Strickland, Esq., of Apperley Court, Tewkesbury.

Petitia Stokesiana, Chitty.

Hab. ——? Hanover (unique).

Form, globose-discoid. *Colour,* pale horn. *Sculpture,* lines of growth visible: 4 widely separated, rather strong, slightly raised, rounded spiral carinæ; 1 finer; 2nd to 7th strong, and 1 finer close below; 8th strong (the one at the periphery strongest and rather sharp), and 2 very faint, round, and distant from the umbilicus; on the upper whorls 5. *Spire,* very little elevated, with rather concave outlines. *Apex,* somewhat mammiform. *Whorls,* 4, well rounded, with a deep suture. *Aperture,* semicircular, altogether rather depressed, very slightly constricted, not spreading, moderately detached from penult whorl. *Labrum,* scarcely produced above, thickened, slightly reflected; smooth and white, not pectinated. *Labium,* well detached from body-whorl, on a plane with labrum, almost straight within the aperture, white, thickened and expanded towards the umbilicus, much so below, but most so and somewhat pointedly in its centre. *Umbilicus,* broad and deep. *Labral lamella,* much expanded at a distance from its junction with the labrum, becoming very fine as it fades into the umbilicus. *Operculum,* ——?

Height 0·049, greatest breadth 0·08, least breadth 0·061.

Named in compliment to Capt. Lort Stokes, R.N., late of H.M.S. 'Acheron,' a zealous collector.

Petitia Grevilleana, Chitty.

Hab. Yallahs Hill.

Form, globose-discoid. *Colour,* pale horn. *Sculpture,* striæ of growth visible; 5 strong spiral carinæ, with 5 less strong intervening: on the upper whorls, 2 strong, with the lesser intermediate ones (this might almost be classed in the 2nd division of *Wilkinsonæa*). *Spire,* slightly elevated, with straight outlines. *Whorls,* $3\frac{2}{3}$rds, well rounded, with a well impressed suture. *Aperture,* obliquely elliptic, more expanded in the upper than lower portion, slightly campanulate on the right owing to a slight constriction behind the labrum. *Labrum,* very slightly produced above, thickened and reflected at about its middle. *Labium,* below the plane of the labrum above, slightly curved to the right below and thickened, slightly detached from body-whorl. *Umbilicus,* not deep, broad. *Labral lamella,* slightly developed. *Operculum,* moderately concave, shining, but with very fine granulations.

Height 0·05, greatest breadth 0·069, least breadth 0·057.

Named in compliment to my friend Dr. R. K. Greville, of Edinburgh.

Petitia Carpenteriana, Chitty.

Hab. Pool's Rock, Hanover.

Form, globose-discoid. *Colour,* —— ? *Sculpture,* striæ of growth visible: 8 strong*est* spiral carinæ and 1 strong; 5 strongest and 1 strong in each interspace; and 2 strong*er* round the umbilicus: on the upper whorls 3. *Spire,* much depressed with convex outlines. *Whorls,* $3\frac{2}{3}$rds, moderately rounded, with a deep suture. *Aperture,* semicircular, rather constricted behind the labrum, not expanded, very slightly detached from the body-whorl. *Labrum,* not produced above, smooth, rather double, inner edge sharp, the strong*est* lines terminating abruptly at the outer edge. *Labium,* very slightly curved to the right below, well detached from the body-whorl, lower than the plane of the labrum below. *Umbilicus,* very shallow and broad, much covered by the *labral lamella,* which is much and widely produced above. *Operculum,* —— ?

Height 0·038, greatest breadth 0·07, least breadth 0·054.

Named in compliment to P. P. Carpenter, Esq., of Warrington, author of an excellent Catalogue of the Mazatlan Shells in the British Museum.

Petitia (? Lewisia) Barroniana, Chitty.

Hab. —— ? (unique).

Form, globose-discoidal. *Colour,* —— ? *Sculpture,* 20 spiral carinæ, 7 of which are rather more prominent, namely the 2nd, 4th, 8th, 12th, 16th, 18th and 19th: on the upper whorls, 6. Striæ of growth visible. *Spire,* much depressed, with straight outlines. *Whorls,* 4, moderately rounded, with a light suture. *Aperture,* much constricted at the labrum, semicircular, widely separated from the body-whorl. *Labrum,* not produced above, simple, thin, rather

double, slightly and coarsely pectinated on the inner edge, much thickened and slightly reflected. *Labium*, much reflected, moderately curved below, on a plane with the labrum above, lower below. *Umbilicus*, moderately deep, very broad, much concealed by the *labral lamella*, which spreads enormously and suddenly above, exteriorly convex (? *Lewisia*). *Operculum*, very deeply concave in the centre, finely granulated, upper margin broad, and indented on the labral side, and enormously spread convexly over the lower end of the labium; almost equal to the spread of the labral lamella, deeply grooved at the lower end, terminating in a linguiform projection.

Height 0·048, greatest breadth 0·084, least breadth 0·065.

Named in compliment to Charles Barron, Esq., Curator of the Royal Naval Museum, Haslar.

[To be continued.]

November 10, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

On several New Species of Birds from various parts of the World. By John Gould, V.P., F.R.S. etc.

Mr. Gould called attention to three species of Australian birds collected by Mr. Elsey during the recent expedition under A. C. Gregory, Esq., from the Victoria River on the north-west coast to Moreton Bay: two of these birds were of especial beauty and interest, viz. a *Psephotus* and a *Malurus*. The former is allied both to the *P. pulcherrimus* and *P. multicolor*, but differs from either, among other characters, by the rich yellow mark on the shoulder; and the *Malurus* is distinguished from all the other members of its genus by its larger size and by the beautiful lilac circlet which adorns the crown. The third species alluded to was a *Petroica*, allied to the *P. superciliosa*, a bird discovered by the late Mr. Gilbert in the neighbourhood of the Burdekin Lakes, and which with the present would admit of separation from the other species of the genus.

For the Parrakeet Mr. Gould proposed the name of

Psephotus chrysopterygius.

Male.—Band across the forehead, extending above the eye to its posterior angle, very pale yellow; on the centre of the crown a patch of black; sides of the head, cheeks, neck, throat, upper portion of the abdomen, lower part of the back, rump and upper tail-coverts, verditer blue, somewhat greener on the cheeks and upper tail-coverts; immediately below the eye a tinge of yellow; back of the neck, back and scapularies, light greyish-brown, slightly tinged with green; shoulder and lesser wing-coverts fine yellow; primaries and secondaries black, margined externally with blue; feathers of the lower part of the abdomen, vent, and under tail-coverts, light scarlet, margined with greyish green; two centre tail feathers dark green at the base, passing into deep blue towards the extremity, and tipped with

dull black; the remaining tail feathers light green crossed by an irregular oblique band of dull bluish black, beyond which they become of a paler glaucous green, until they end in white; but each has a dark stain of bluish green on the outer margin near the tip; irides brown; bill and nostrils bluish horn-colour; feet mealy grey.

Total length, 11 inches; bill, $\frac{3}{8}$; wing, $4\frac{1}{4}$; tail, 7; tarsi, $\frac{1}{2}$.

Female.—Similar to the male in colour, but all the hues much paler, and the markings much less strongly defined.

Young.—In this state the whole of the head, all the upper surface, wing-coverts, throat, and breast are of a pale glaucous green; the rump and upper tail-coverts and the tail similar to the same parts in the male, but not so bright; and the lower part of the abdomen is greyish white, with faint stains of scarlet.

In the notes accompanying the specimens, Mr. Elsey states that they were procured on the 14th of Sept., 1856, in lat. 18° S. and long. 141° 30′ E., that their crops contained some monocotyledonous seeds, and that the *os furcatorium* was small, but well-developed; of this he was certain, as he had a discussion with Mr. Gregory on the subject, and dissected on the same day *Platycercus palliceps* and *Aprosmictus erythropterus,* and noticed that while the former was entirely destitute of that bone, and had only a weak ligamentous band in its place, the latter had a distinct os furcatorium closely resembling that of *Psephotus.* He remarked, too, that the flight of the *Psephotus* was swift and decided; and adds, that he never saw it on the ground, although the contents of its crop would indicate that it obtained its food there.

The Malurus Mr. Gould designated

Malurus coronatus.

Male.—Crown of the head rich lilac purple, with a triangular spot of black in the centre, and bounded below by a band of velvety black, which commencing at the nostrils passes backwards through the eye, dilates upon the ear-coverts, and meets at the back of the neck; back and wings light brown; tail bluish green, becoming of a deeper hue towards the extremity; lateral feathers margined externally and tipped with white; under surface buffy white, becoming gradually deeper on the flanks and vent; irides brown; bill black; feet fleshy brown.

Total length, $6\frac{1}{2}$ inches; bill, $\frac{3}{4}$; wing, $2\frac{1}{4}$; tail, $3\frac{5}{8}$; tarsi, $1\frac{1}{8}$.

Female.—All the upper surface light brown; lores and space behind the eye white; ear-coverts chestnut; in other respects similar to the male.

Hab. Victoria River, North-Western Australia.

The Petroica he proposed to call

Petroica? cerviniventris.

All the upper surface, wings and tail chocolate-brown; line over the eye, throat, tips of the greater wing-coverts, base of the prima-

ries, base and tips of the secondaries, and tips of the tail, white; breast grey; abdomen deep fawn colour, becoming almost white in the centre; bill black; feet blackish brown; irides dark brown.

Total length, $6\frac{1}{2}$ inches; bill, $\frac{3}{4}$; wing, $3\frac{1}{4}$; tail, $3\frac{1}{4}$; tarsi, $\frac{7}{8}$.

Hab. Victoria River, North-western Australia.

The three birds above described are in the British Museum.

The next species to which Mr. Gould directed attention was a new Hawk belonging to the genus *Spilornis*, and which differs remarkably from the *S. undulatus* or Bacha of the continent of India, and the *S. holospilus* of Manilla.

For this bird he proposed the appellation of

Spilornis rufipectus.

Crown of the head and the lengthened feathers of the occiput deep black, the occipital plumes margined at the tip with rufous; feathers at the nape black, margined with rufous, showing conspicuously; all the upper surface and wings dark chocolate-brown, with paler edges; chin and sides of the neck greyish black; chest deep cinnamon-brown; primaries and secondaries blotched with white at intervals on their internal web; under wing-coverts, abdomen, vent, thighs, and under tail-coverts cinnamon-brown, crossed by bands composed of two large spots of white bounded above and below with a narrow line of black; tail dark brown, crossed near the base by a narrow and not very distinct band of greyish, and near the apex by broad bands of a lighter hue passing into whitish on the edges of the internal webs and narrowly edged at the tip with pale reddish-brown and white; bill blackish-brown; the cere, naked orbits, and feet appear to have been yellow.

Total length, $19\frac{1}{2}$ inches; bill, $1\frac{3}{8}$; wing, $13\frac{1}{4}$; tail, 9; tarsi, $2\frac{3}{4}$.

Hab. Celebes, vicinity of Macassar. From the collection of Mr. Wallace.

The next was a highly interesting species of Bullfinch, which he designated

Pyrrhula aurantiaca.

Male. Bill, face, wings, and tail deep purplish-black; rump, upper and under tail-coverts white; the remainder of the upper and under surfaces rich reddish-orange, deepest above; the lesser wing-coverts are also reddish-orange, as is the apical half of the innermost of the greater wing-coverts, while the outer ones are slightly tipped with buffy-white; irides black; feet pinky-flesh colour.

Total length, $5\frac{1}{8}$ inches; wing, $3\frac{1}{4}$; tail, $2\frac{3}{8}$; tarsi, $\frac{5}{8}$.

Female. Has the black circle round the bill; head and neck ash-coloured; back ash colour, tinged with orange-red; lower parts like those of the male, but much less brilliant and approaching to olive.

For his knowledge of this pretty species Mr. Gould was indebted to the researches of Dr. A. Leith Adams of the 22nd Regiment, who killed it on the Western Himalayas, and who states that he

first met with it in the month of March 1852, on one of the wooded slopes of the Pir Pinjal Mountains, westward of the valley of Cashmere; its habits closely resemble those of *P. erythrocephala*, frequenting as it does thick bushy places, and being usually seen in small societies. It is not uncommon in the valleys and jungles around Cashmere. Dr. Adams remarks that, although the two species are so similar in their habits and in the localities they frequent, he never met with them in company; but noticed that while the *P. erythrocephala* was tolerably abundant in the ranges around Simla, the present species was only seen on the hills in the neighbourhood and to the westward of Cashmere. Its call is not so loud as that of *P. vulgaris*, and somewhat resembles the chirp of the Greenfinch, *Chlorospiza chloris.*

For a new Motmot Mr. Gould proposed the name of

MOMOTUS ÆQUATORIALIS.

Crown of the head deep black, surrounded by a zone of verditer green, to which succeeds a line of fine deep blue from the anterior portion of one eye round the occiput to the anterior portion of the other; to this succeeds a fringe of deep black from the nostrils round the back of the neck; lores, space below the eye and ear-coverts black, with a very fine fringe of blue on the lower edge and a small tuft of verditer green at its hinder extremity; all the upper surface green, washed with cinnamon on the shoulders; primaries green on their external webs, black on the inner; tail dark bluish-green; under surface green, washed with cinnamon and with a tuft of broad round black feathers, margined at their base with verditer green, in the centre of the breast; bill black; feet blackish-brown.

Total length, 16 inches; bill, $2\frac{1}{8}$; wing, $6\frac{1}{2}$; tail, $8\frac{3}{4}$; tarsi, $1\frac{1}{4}$.

Hab. Archidona, near the Equatorial line, on a branch of the Rio Napo.

Remark.—This is a large and robust species, and differs from all others in the broad spatulate feathers of the breast tuft.

A very fine *Odontophorus*, remarkable for the rich chestnut-red colouring of its under surface, received the appellation of

ODONTOPHORUS HYPERYTHRUS.

Crown of the head, wings, and upper surface of the body dark brown, minutely freckled with black; orbits naked, beset with minute white feathers continued in a stripe behind the eye; on the centre of the back and wing-coverts are large blotches of velvety-black; and at the tip of the innermost secondaries a small oval spot of buff; throat, sides of the chest, breast, and abdomen dark chestnut-red; vent, thighs, and under tail-coverts blackish-brown, indistinctly banded with dark sandy red; tail nearly black; bill and feet blackish-brown.

Total length, 10 inches; bill, $\frac{7}{8}$; wings, $5\frac{3}{4}$; tail, $2\frac{1}{2}$; tarsi, $2\frac{1}{8}$.

Hab. Santa Fé de Bogota.

Remark.—For this bird Mr. Gould is indebted to the Messrs.

Verreaux of Paris, who obtained it in a collection from Santa Fé de Bogota. In size it fully equals, if it does not exceed, *O. dentatus* and *O. speciosus,* from which latter it differs in the total absence of any black on the throat.

BOTANICAL SOCIETY OF EDINBURGH.

November 12, 1857.—Professor Balfour, V.P., in the Chair.

The Chairman gave an account of an excursion with some of his pupils to Arran. The party collected 500 species of plants, of which 1-25th consisted of true Ferns.

The following papers were read :—

1. "Notice of Abnormality in a Flower of *Lilium,*" by J. Christian, Esq.

In this Lily there are ten sepals, eleven stamens, and two ovaries; the petiole is slightly flattened, and appears to be formed of two petioles united. The monstrous flower is undoubtedly formed, not by the growth of additional parts, nor by the splitting of organs during their development, but by the fusion of two flowers into one. According to this view, the number of parts should be as follows :— sepals, twelve; stamens, twelve; ovaries, two. Two of the sepals seem to be lost by adhesion, as is indicated by two of them presenting a slight cleft towards the apex, showing apparently that they are double. Add this number two to the number actually in the flower, ten, and we have the proper number, twelve. There were only eleven stamens. He is unable to account for the missing stamen further than by supposing that it may be due to adhesion or abortion.

2. "Short Notice of a peculiar form of Fungus," by James Young, M.D.

It was found by Dr. Young while assisting Mr. Edwards in the operation of excision of the knee-joint. The patient (an Irishman) was, after the operation, laid on a new and clean bed, with a hair-mattress, which had been previously covered with gutta-percha sheeting. The patient lay in considerable comfort for some days. The bed, however, became very soon damp, and it was found necessary to have him changed. On the fourteenth day after the operation, he was removed from the bed till the mattress was changed, and a new one substituted, when attention was directed to an extraordinary appearance on the under part of the bed, where the Fungus was produced in large quantity, growing both from the spar and from the mattress. The bed was thoroughly cleaned; but in spite of this, at the expiry of nine or ten days, the same appearance was again presented, the Fungus being nearly in equal quantity as before.

3. "Remarks on the above Fungus," by the Rev. M. J. Berkeley, M.A., F.L.S.

The Fungus is an imperfect state of some *Coprinus.* A similar case is reported in some Italian Transactions, and I recollect one

which occurred at St. George's Hospital in 1825. The treatise to which I allude is entitled 'Sopra alcuni Funghi ritrovati nell' apparechio di una frattura. Modena, 4to, 1805. Targioni-Tozzetti.'

4. "Notice of the discovery of a new station in Britain for *Polygonatum verticillatum*," by the Rev. W. Herdman.

The station is Drimmie Burn Den, near Glen Ericht Cottage, parish of Rattray. It was found at Strone of Cally, by Dr. Barty, some years ago, and has been long known at Craighall. The Drimmie station is nearly intermediate in position between these two places, which are about four miles apart.

December 10, 1857.—Dr. Seller, President, in the Chair.

The office-bearers for the ensuing year were elected, viz.:—

President, Dr. Seller; *Vice-Presidents,* Professor Gregory, Professor Balfour, Dr. W. H. Lowe, Andrew Murray, W. S.; *Secretary,* Dr. Greville; *Assistant-Secretary,* Dr. George Lawson.

The following papers were read:—

1. "Notice of Egyptian Plants," by Dr. John Kirk.

Dr. Kirk gave a short account of a tour in Egypt and Syria during the spring of 1857, and exhibited specimens of the more interesting plants.

2. "Notice of Plants found in the neighbourhood of Comrie, Perthshire," by Mr. D. P. Maclagan.

Mr. Maclagan called attention to the importance of a knowledge of local floras, as a means of extending our knowledge of the geographical distribution of plants. After a few remarks on the situation and climate, he described some of the more important parts of the district, and laid a detailed list of the plants on the table; including varieties, 442 had been noted, consisting of Thalamifloræ, 68; Calycifloræ, 98; Corollifloræ, 120; Monochlamydeæ, 37; Florideæ, 30; Glumiferæ, 70; and Acrogenæ, 19.

3. "Contributions to Microscopical Analysis. No. 1. Tobacco," by Dr. George Lawson.

Dr. Lawson called attention to the imperfect descriptions that existed of the histological characters of tobacco, and the consequent liability to error in microscopical analysis. It has been customary to characterize the tobacco as distinguished by its hairs being 'glandular,' or having an 'enlargement' or 'roundish swelling' at the tips; but this very imperfectly indicates the peculiar structure of these hairs, which, although extremely variable in size and general form, present certain characters in their lower cells, and in the structure of the glands at their tips, which are very constant and of great practical value. The characteristic hair of the tobacco-leaf varies from 1-20th to 1-100th of an inch in length, and is generally thick and gouty at the base, and tapering towards the extremity where the glandular structure is placed; that structure is of an oval or

rounded form, and consists of a few closely packed but well-defined cells, which are very much shorter than the other cells of the hair. The elongated cells of the body of the hair (of which the lower one is most characteristic on account of its very large size), contain fine colourless, granular matter, and generally nuclei; but the secreting cells are well furnished with colouring matter of a reddish-brown, but sometimes of a green colour. A one-inch object-glass, recommended for the examination of tobacco, is usually insufficient to show the *structure* of the gland, and the mere presence of 'glandular hairs' proves nothing, these being common in plants. It is also necessary to keep in view that many small hairs occur on tobacco-leaves which are normally without glands. The glandular hairs are most abundant at the tips of the shoots, and especially on the calyx and flower-stalks of the tobacco. To the fact that epidermal hairs are so frequently organs of secretion, Gasparrini has recently added the additional one, that they are also the organs of absorption.

4. "Notice of Galls found on the Leaves of the Beech," by Mr. James Hardy.

GEOLOGICAL SOCIETY.

January 6, 1858.—Major-General Portlock, LL.D., President, in the Chair.

The following communications were read:—

1. "On *Cephalaspis* and *Pteraspis*." By Prof. Huxley, F.R.S., F.G.S.

Of the four species originally included by Prof. Agassiz in the genus *Cephalaspis*, two, *C. Lloydii* and *C. Lewisii*, are so different from the others that the possibility of their proving generically distinct is hinted at in the 'Recherches sur les Poissons Fossiles.'

Subsequently M. Kner endeavoured to prove that these two species are not fish-remains at all, but are the internal shells of a Cephalopod, for which he proposed the generic name of *Pteraspis*.

Roemer has still more recently expressed the opinion that the *Pteraspides* are *Crustacea*. These conflicting opinions clearly indicate the necessity of revising and comparing anew the characters of the different species of *Cephalaspis* and *Pteraspis*. And a still greater interest is lent to the inquiry into the true nature of *Pteraspis*, from the fact that species of this genus are now known to occur in undoubtedly Upper Silurian rocks. As the evidence stands at present, they are, if fish, among the oldest (and nearly the very oldest) representatives of their class.

In undertaking this inquiry, the author of the present paper considered it desirable, in the first place, to determine with precision the microscopical characters of the shield of *Cephalaspis*. This shield is exceedingly thin, nowhere exceeding $\frac{1}{40}$th of an inch in thickness on the dorsal surface, and on the ventral suddenly thinning off a little way from the margin into a mere membrane.

The subjacent cranium appears to have been wholly composed of cartilaginous or soft fibrous tissue; for the "layer of fibrous bone,"

which has been said to exist immediately beneath the shield, is in reality nothing more than the matrix, which in these fossils, as in others, is stained of a deep reddish-brown colour in the immediate neighbourhood of the animal substance; the "fibres" of the supposed bone are casts of the radiating semi-canals or grooves on the under surface of the shield.

The shield consists of three principal layers; the outermost is distinctly laminated, and contains numerous osseous lacunæ, whose long axes are disposed at a considerable angle to one another in the successive layers, as in *Megalichthys*. The lamellæ and lacunæ disappear in the middle and outer layers. The latter is arranged in irregular tubercles, consisting of a substance very similar to the "Kosmine" of Prof. Williamson. The inner openings of numerous vascular canals are seen as points scattered over the inner surface of the shield. These canals traverse the inner layer obliquely, and then ramify in the middle layer in a very peculiar manner, described at length in the paper.

It is from the disposition of these vascular ramifications that the appearance of distinct ossicles or scales, interlocking by sutures, which has been described, arises. The entire absence of any such appearance of sutures on the inner surface of the shield is, indeed, alone sufficient to prove that it is not composed of distinct scales.

In the shield of *Pteraspis* three principal layers are similarly discoverable: the inner is very distinctly laminated; the outer, almost wholly constituted by the characteristic "enamel-ridges," consists of Kosmine. Vascular canals pass from the inner surface, and ramify in the middle layer, terminating in cæca in the outer layer, as in *Cephalaspis*.

But there are no osseous lacunæ; and the vascular canals communicate with large polygonal cells (which were either empty, or more or less occupied by membranous substance in the recent state) situated in the inner part of the middle layer.

Specimens were exhibited in which these cellular cavities were empty; but ordinarily they are filled with the matrix, which then assumes the form of polygonal prisms separated by the thin walls of the cells. It is these prisms which have been mistaken for part of the bony structure itself.

On examining a thin section of one of M. Kner's specimens (for which the author is indebted to the liberality of Sir P. Egerton), the structure, though much altered, showed sufficient similarity to that of the specimens of *C. Lloydii* in the Museum of the Society to leave no doubt as to the generic identity of the two.

The microscopic examination of *Pteraspis* demonstrates its unquestionably piscine nature; and shows that, while in many respects similar to *Cephalaspis*, the species included under *Pteraspis* are rightly separated from the others. The leading distinctive characters of the former are the absence of osseous lacunæ,—the cellular character of the middle layer,—and the ridged and not tuberculated enamel.

In conclusion, the author inquired into the evidence of the Ganoid nature of the *Cephalaspidæ*, and into the value of the relative and

absolute development of the endo- and exo-skeletons in fishes, considered as indications of the perfection of their general organization.

2. "On a New Species of *Plesiosaurus*; with Remarks on the Structure of the Atlas and Axis, and of the Cranium in that genus." By Prof. Huxley, F.R.S., F.G.S.

The specimen which is the subject of the present paper was procured at Street, near Glastonbury. It is now in the Collection of the Museum of Practical Geology, Jermyn Street, and will be described at length in the Decades of the Geological Survey.

It approaches most nearly to *P. Hawkinsii*; but the head is smaller in proportion to the body and neck, and the number of the cervical and dorsal vertebræ is different, there being altogether fifty-three cervico-dorsal vertebræ, of which thirty are cervical; while in *P. Hawkinsii* the cervical vertebræ are thirty-one, and the dorsal at least twenty-three. For this species, characterized by fifty-three cervico-dorsal vertebræ,—by a cranium at most not more than $\frac{1}{12}$th of the length of the body, and by having the anterior thirty vertebræ fully, or more than, equal to four lengths of the cranium, the name of *P. Etheridgii* is proposed. Its dimensions are nearly the same as those of *P. Hawkinsii*, its length being between 7 and 8 feet.

By a happy accident the only displacement in the whole length of the vertebral column of this specimen has taken place between the head and the atlas and axis, on the one hand, and between the latter and the third cervical vertebra on the other. By a little careful clearing away of the surrounding parts, it has thus been possible to expose the atlas and axis very easily. They are, as Prof. Owen has stated to be their character in this genus, anchylosed; but their structure is totally different from what is seen in the *Ichthyosaurus*, and closely resembles that of the corresponding parts in the Crocodile. An os odontoideum, very similar to that in the Crocodile, represents, as Rathke long since demonstrated in other *Reptilia*, the central portion of the body of the atlas; while its cortical inferior portion and its neural arches form an anterior articular cup for the occipital condyle, as in the Crocodile.

The author next adverts to the many points of structural correspondence observable between *Plesiosaurus* and *Teleosaurus*, not only as regards the atlas and axis, but as respects the cranium.

The existence of a distinct jugal and squamosal, and of a union between the latter and the post-frontal, and the consequent subdivision of the temporal fossa, as in the Crocodile, are indicated. The extension of the exoccipitals and of the pterygoids to the os quadratum is adverted to; and the very backward position of the posterior nares ascribed to *Plesiosaurus* is questioned. Teleologically, such an arrangement appears not very comprehensible: and, on morphological grounds, it is unlikely; for the posterior nares are more forward on the base of the skull in *Gavialis* than in *Crocodilus*, and far more forward in *Teleosaurus* than in *Gavialis*. It seems more probable that the so-called posterior nares of *Plesiosaurus* correspond with the deep fossæ on either side of a prominent median ridge visible on the under surface of the basisphenoid of *Teleosaurus*.

The petrosal bone, completely covered externally by the quadratum in *Crocodilus,* is partially exposed in *Gavialis,* and completely so in *Teleosaurus* and in *Plesiosaurus.*

Similar comparisons were pursued with respect to other parts; and it is shown that in many respects the *Teleosauria* bridge over the gap between the long-necked *Enaliosauria* and the existing *Crocodilia,*—a conclusion not without interest, when the relations in time of the two orders are considered.

MISCELLANEOUS.

List of Diatomaceæ, *&c., found in Ceylon.* By Dr. KELAART.

Amphora, sp.
Eunotia amphioxys.
Himantidium gracile.
—— arcus.
Navicula firma.
—— serians.
—— lævissima.
—— bifrons.
—— rhomboides.
Stauroneis gracilis.
Pinnularia acuminata.
—— mesolepta.
—— viridis.
—— viridula.
—— gibba.
Surirella panduriformis.
Nitzschia curvula.
Melosira distans.
Hanoptera semen.
Three species of Nitzschia, probably new.
Gyrosigma tenuissimum.
—— lacustre.
Tryblionella, sp.
Amphipleura, sp.
Atrikostoma falcatum.

Vorticella nebulifera.
Carchesium polypinum.
Arcella enchelys.
Trachelocerca biceps.
Euglenia, sp.
Chætophyta cinnamomea, sp. n.
Difflugia liosoma.
—— Lioptomum.
Trachelomonas gigas.
—— lævis.
—— granulata.
—— nigra.

On the Claws of the Spiders of the genus Mygale. By M. H. LUCAS.

M. Lucas has recently stated to the Academy of Sciences in Paris, that the claws of the tarsi of the *Mygale Blondii* and *M. nigra,* which are inserted above the tarsus, are very mobile, and that they are exserted or retracted by the animal at pleasure, somewhat in the same way as those of the carnivorous mammals of the genus *Felis.* He has also observed that in these species the hooks of the mandibles are but slightly moveable, and that they are not developed to the same extent as in many other spiders, such as those of the genera *Segestria, Epeïra, Tegenaria,* &c.

During his stay in Algeria on two occasions, M. Lucas had the opportunity of examining several species of the genus *Mygale,* amongst others *M. barbara, gracilipes,* and *africana,* and in these he observed that the claws were terminal and non-retractile. In these species also the hooks of the mandibles are greatly developed, and serve

either for digging out galleries in the earth, or for wounding the insects which constitute their prey.

From this observation the author proposes to form two divisions in the genus *Mygale*. These are,—

Division A. Claws not terminal, inserted above the tarsus, retractile; hooks of the mandibles but slightly moveable and not much developed. *Mygale Blondii, nigra*.

Division B. Claws of the tarsi terminal, not retractile; hooks of the mandibles much developed. *Mygale barbara, gracilipes, africana*.

The species of the genus *Mygale* in which the tarsi are clothed beneath with short, close hairs, forming a sort of brush, have the claws retractile and not terminal. Those on the contrary which have elongated hairs instead of a brush on the lower surface of the tarsi, have the claws terminal and not retractile.—*Comptes Rendus*, 28th December, 1857, p. 1103.

Notice of a Large Species of Lineus? *taken on the Coast near Montrose.* By Dr. John E. Gray, V.P.Z.S. F.R.S. &c.

Mr. Beattie, the Secretary of the Museum of the Natural History Society of Montrose, has kindly presented to the Museum a fragment including the head of a large marine worm which was taken off the coast near Montrose on the 18th July, 1857.

Mr. Beattie has accompanied the specimen with a figure, and the following note respecting it:—

"Length varies from 18 to 20 inches. After having been taken a few hours, it divided itself into two pieces of nearly equal length, the posterior of which divided itself into 32 different pieces, all of which seemed to me to move for a whole day; the head part, continuing to live for two days, moved about, changing its shape continually, and now and then throwing off an additional joint."

The head portion which is in the British Museum resembles the fragment of a very large *Lineus*, with a large longitudinal mouth opening into a longitudinal cavity, which extends the whole of its length, having a central, broad, longitudinal rounded ridge extending the whole length of the dorsal surface. The sides of the body are irregularly torn.

The specimen is in far too imperfect a condition to describe, but I think that it may be provisionally named *Lineus Beattiæi*, after its discoverer; and I hope that we may be favoured with a more perfect description of the animal made from a living specimen.

I may observe, that there is a large round hole in the centre of the lower part of the body, about one-fourth the entire length from the mouth, which has been mistaken by some persons for the vent; but it is evidently an artificial perforation extending entirely through the substance of the body, and piercing both surfaces of the central cavity.—*Proc. Zool. Soc.* July 28, 1857.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 3. MARCH 1858.

XVI.—*On the Nidification of Crustacea.* By C. SPENCE BATE, F.L.S., Corr. Memb. of the Dublin University Zoological and Botanical Association*.

[With a Plate.]

THAT animals build nests, some for temporary and others for permanent occupation, is well known; but that any which dwell beneath the sea should do so, was not formerly supposed possible; and I believe that it is among the more recent of discovered facts that some species of Crustacea habitually dwell in abodes of their own construction.

The American naturalist, Say†, was the first who discovered one of the Amphipoda in a small tube which he believed it to occupy as a tenant, in the same way as the *Pagurus Bernhardus* takes possession of the shell of the Whelk, &c. The tube, which was cylindrical, membranaceous, diaphanous, and open at each end, Say thought to have been constructed by an Annelid which had either vacated or been driven from its home; the tube was then taken possession of by the Amphipod.

For this animal Say established the genus *Cerapus*, and named the species *tubularis*. He describes the animal as being very active, running with great facility amongst the branches of Fucus, Sertularia, &c., although encumbered by its tube, and, what he thought to be very extraordinary, made use of its four antennæ only as feet, the proper feet being all included within the tube, with the exception of the two anterior pairs (gnatho-

* Communicated by the author, having been read at the Plymouth Institution and Devon and Cornwall Natural History Society, on Feb. 1st, 1858.

† Trans. Philad. Soc. vol. i.

poda), which are used only to seize prey and convey it to the mouth.

"The tube is always proportioned to the size of the animal, and appears to invest it closely; nevertheless, when the animal is prevented from proceeding onwards, it turns its body immediately, protrudes its head from the opposite extremity, and thus makes use of either end indifferently as the anterior part.

"When swimming about, one-half of the body is projected from the tube, and is suddenly and repeatedly inflected, so as to proceed forwards by jerks."

We thus perceive that Say was on the verge of a very interesting discovery in the habits of the small Crustacea, but, yielding to analogous facts, fell short of arriving at the truth.

Mr. Templeton, in the 1st volume of the Transactions of the Entomological Society, describes a Crustacean of the same genus which he observed likewise to dwell within a tube, and which he named *Cerapus abditus.*

Alluding to another species of this genus, Mr. Stimpson says, in his 'Marine Invertebrata of Grand Manan,' "The *Cerapus rubricornis* inhabits flexible tubes, of sizes corresponding to those of the individuals, composed of fine mud and some animal cement by which it is agglutinated. These tubes are generally adherent for about one-half their length, and closed below. They are usually found in large groups, attached to submarine objects and to each other. The animals are very active, protruding and retracting the anterior portion of their bodies, while their antennæ are in continual motion, lashing about in search of some object which might serve for food. It is very amusing to watch a colony of these animals, with their comical gestures in their disputes with each other, and their awkward celerity in regaining their respective tubes after having left them on temporary excursions. I have in no instance met with an individual transporting a free tube, as is said by Mr. Say to be the case with his *C. tubularis.* There can be no doubt but that the tube is fabricated by the animal; and this is not without precedent in the Crustacea, for I have often met with examples of *Pagurus* which had enlarged their borrowed shells by additions to their apertures*. From what I have seen in such species of *Corophiidæ* as have fallen under my observation, I am inclined to think that most of the members of that family form more or less permanent tubes under certain circumstances. The *Unciola,* when kept in captivity, will frequently retire to some corner, and collect the sand around it by some glutinous substance so as to form a cavity, in which it will often remain for some time; but it may

* These additions are the result of a sponge growing upon the shell, and not built by the Crab.—C. S. B.

be easily made to leave it, and will make another if it be destroyed. On the other hand, some of the other individuals in the same jar will make no tubes; and often, at low water, they may be seen swimming about, perfectly free. The same is true of some of the other species of the family here mentioned, and of many species whose habits I had opportunities of observing in the harbour of Charleston, S.C., in the winter of 1851–52."

Kröyer, in his great work on 'Scandinavia,' &c., figures a previously undescribed Crustacean of the same order under the name of *Siphonocetus typicus* (Pl. VIII. fig. 1), which he found to inhabit small cases (not unlike those made by the Caddis-worm), built of small pebbles, sand, &c. Beyond these facts, I am not aware of any observations being published upon this curious subject.

Some years since, before I gave much attention to the subject, I had in a glass case a few Amphipoda in sea-water, with a little weed. After a short time, an hour or two, I was surprised to find that one of these small creatures had managed to bend round a portion of a leaf of green Ulva upon itself, and cement the same into a tube-like case, in which it lived, putting out its head and antennæ only; upon being disturbed at one extremity, it would quickly turn within its abode, and protrude its head at the other. I thought it curious at the time, but pursued it no farther, until more recent and longer-extended opportunities showed me that these were by no means isolated instances among Crustacea, but that a large and well-marked group enjoy this power; and that this group is again capable of being divided,—one division being distinguished by the construction of tubes open (occasionally?) at each end, the other by cases bearing a closer resemblance to nests, irregular in form, short, and open only at one extremity.

The animals which construct these two kinds of abodes possess an external structure that distinctly separates them from one another, and both again are distinguishable from the burrowers, or those which dwell in abodes that they have made by excavating channels in clay, mud, or wood.

Together these three groups form the family *Domicola* among the Amphipods, but separately they represent distinct subfamilies, the value of which rests upon the structure of the animal composing each.

It is upon a clear appreciation of this structure that the genus *Amphitoë* has been removed from the position that has generally been assigned to it by authors, viz. near to *Gammarus*, and placed among the *Podocerides*.

When engaged in making observations for the "Report on the British Amphipoda" for the British Association, I kept in a glass

case several specimens of *Amphitoë rubricata* which I dredged up at the east end of the Plymouth Breakwater. These varied in their ages, from the very young to the well-advanced adult. In the small tank they soon separated themselves, and remained at rest in the same place. In these places I found that they shortly constructed for themselves nests which appeared to have been formed partly of foreign materials and partly secreted by the animal. A small area around each lair was swept clean, as if, in building, the animal procured all the material within its reach. And it is highly probable that the quantity of secreted matter is regulated by the greater or less amount of building material at hand. We know, in the Spider, that after constructing one or two webs, its power becomes exhausted. It is therefore desirable that they should economize this capability as much as possible. The *Amphitoë* generally seek out well-sheltered crevices at the roots of the great *Laminaria* (Pl. VIII. fig. 5), under stones and other objects that break the wash of the sea, and there construct abodes for themselves, by scratching together any available material within reach, and uniting it into a mass by a substance which they secrete.

If we take one of these small nests, and place it under a microscope, we find that it consists, independently of the collected material, of a quantity of fine threads, closely woven and knit together, crossing each other in the utmost confusion; and here and there are seen loops formed by a single thread being doubled and spirally twisted upon itself (Pl. VIII. fig. 5 *a*).

Mr. Thompson of Belfast has recorded having taken the common shore *Amphitoë* (*A. littorina*) in a nest; this I have seen, but have had no opportunity of examining its minute structure. It appeared to be more membranous than that of *A. rubricata*, and to be constructed without any foreign materials*.

The *Podocerus* is the next genus with which we are acquainted as possessing this power. A summer or two since, Mr. Howard Stewart brought me a small bunch of *Laomedea*, in the branches of which a colony of *P. pulchellus* had taken up their abode. The nests in this batch assumed a more decided form than those of any other species that I have seen. The form of the nest was narrow at the lower extremity and broad at the upper, at which end, moreover, was an opening into the nest. The top was covered, dome-shaped, except that it somewhat overhung on the side over the entrance to the nest, giving a curved appearance

* Since the above was written, I have received, among other Crustacea, a specimen of *Amphitoë littorina* and its case from Professor Kinahan, of Dublin. This was constructed of bits of weed, sand, &c., bound together by fine threads, similar to that of *A. rubricata*. I could perceive no spiral loops as shown in Pl. VIII. fig. 5 *a*.

to the structure, somewhat resembling a pear. Many of the nests were in what appeared to be an unfinished state. If so, they were constructed bit by bit, commencing from the smaller extremities, which were attached to the stems of the zoophyte. One side appeared to be so closely built-in with that on which it rested, as to render them very secure and strongly fixed.

Another species of this same genus* has been sent to me by Mr. Gosse from Ilfracombe and Tenby, together with the abodes constructed by it. Those found at Ilfracombe were attached to a leaf of green *Ulva.* They were chiefly gathered about the roots of the plant, but some few were constructed further up. The specimen from Tenby had the nests thickly clustered around the base, and were gradually progressing up the stem of an old *Tubularia.*

These nests, when examined under the microscope, appear to be composed of grains of fine mud cemented by some glutinous material that the animal secretes.

Mr. Alder kindly sent me a specimen that he had dredged; it consisted of small mud-tubes, about a quarter (or little more) of an inch in length, four of which were slenderly attached, at one extremity only, to a bit of *Antennularia.* Examination proved them to contain a species of *Siphonocetus* (Pl. VIII. fig. 2). Unlike Kröyer's species, the tubes of this were formed of mud, laid on, layer after layer, in successive rings, giving a somewhat annular appearance to the structure.

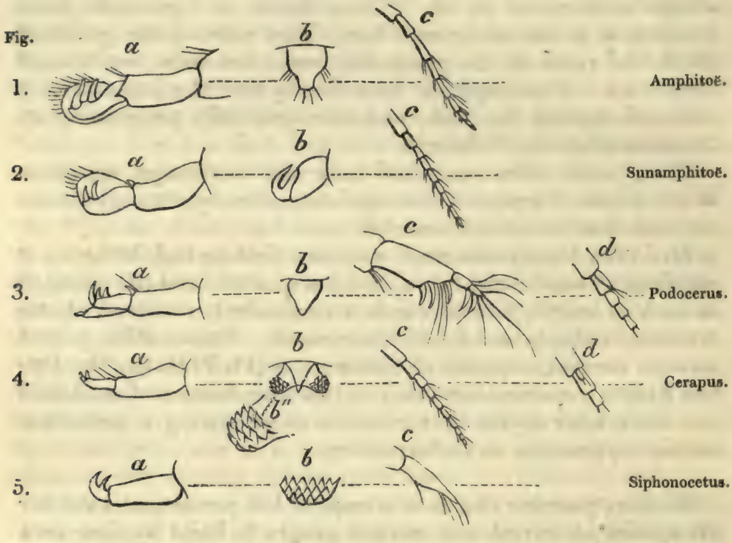
We here perceive that it is a more or less permanent habit for the species of several well-marked genera to build by their own exertions abodes in which they dwell. It is only natural to suppose that, having a common instinct, however varied their general form may be, they must in some parts of their structure possess some features common to the whole. It is upon the force of this argument that this group is separated from others to which in their general form they offer a striking resemblance. Upon the importance of these characters respectively rests the strength of the subfamily *Podocerides* in a natural classification, as distinct from *Corophiides*; for no philosophic naturalist could allow a group to be made if the habit were the only resemblance between species, since an apparent eccentricity (of which this class affords abundant examples) must disturb the arrangement.

Without examining the whole of the generic characters, we shall, I think, be able to exhibit certain well-marked resemblances

* I am inclined to think it is an undescribed species: it more nearly resembles *Podocerus* (*Cerapus*) *fucicola* of Stimpson than either of the other species.

that fully warrant the classification of *Amphitoë, Sunamphitoë, Podocerus, Cerapus,* and *Siphonocetus* into a subfamily.

The most important parts by which classification can be carried out are the appendages at each extremity,—the antennæ and the posterior pleopoda. The gnathopoda also are important; but they frequently differ in the sexes, and a great variety in their formation is compatible with the integrity of a genus.



In *Amphitoë* the upper antenna has no complementary appendage; in the lower antenna, the flagellum (fig. 1 *c*) terminates simply; the posterior pleopod (fig. 1 *a*) is double-branched, one branch being furnished with two or more short, stout spines planted in such a position as to be directed forwards and serve the purpose of hooks; the other is developed in the form of a scale or plate, more or less fringed with fine hairs. The telson (fig. 1 *b*) is a simple plate narrowing posteriorly to an apex.

The genus *Sunamphitoë* is very near to that of *Amphitoë*, the great difference being that the telson of *Sunamphitoë* is developed into a single well-formed and powerful hook (fig. 2 *b*).

In *Podocerus* the upper antenna has a rudimentary secondary appendage (fig. 3 *d*). The flagellum of the lower antenna (*c*) consists of only a few articulations, and the last two are furnished with two or more short, stout, curved, hook-like spines, and a few strong hairs. The posterior pleopod (fig. 3 *a*) is double-branched; the outer branch with two or more hook-like spines,

the inner more styliform than in *Amphitoë,* and tipped with one or more short spines. The telson (fig. 3 *b*) is simple and pointed as in *Amphitoë.*

In *Cerapus* the upper antenna has a very rudimentary secondary appendage (fig. 4 *d*). The lower antenna has a simple flagellum (*c*). The posterior pleopod (*a*) is single-branched, and terminates in two imperfect hooks. The telson (*b*) is double-lobed, each lobe being covered with a number of short points directed anteriorly.

In *Siphonocetus* the upper antenna is without any secondary appendage; the lower has the flagellum reduced to two or three stout articulations (fig. 5 *c*). The posterior pleopod (*a*) is single-branched, the terminal joint being very short, and furnished with two well-formed, powerful hooks. The telson (*b*) is single(?)-lobed, and furnished with a number of short points directed anteriorly.

If we compare the relative parts, we find that the upper antennæ of *Amphitoë, Sunamphitoë,* and *Siphonocetus* are without secondary appendages; while those of *Podocerus* and *Cerapus* have them in rudimentary (microscopic) forms. The lower antennæ of *Amphitoë, Sunamphitoë,* and *Cerapus* alike possess simple flagella; while those of *Podocerus* and *Siphonocetus* have the flagella reduced to two or three strong articulations furnished with stout hairs, some of which in *Podocerus* are reduced to short, curved spines. The posterior pleopod scarcely differs in *Amphitoë, Sunamphitoë,* and *Podocerus*; and in *Cerapus* it differs from *Siphonocetus* in the absence of the squamiform branch. The telson in *Amphitoë* resembles that of *Podocerus,* while the telson of *Cerapus** differs from that of *Siphonocetus* in the former being double- and the latter being single-lobed; whereas the telson of *Sunamphitoë* is peculiar to itself.

The hairs with which many of these Crustacea are furnished evidently constitute a peculiar feature in this small group. Losing their soft and pliant form, they assume that of short points, strong spinous processes, and curved hooks. These changes are brought about to serve some efficient purpose in the œconomy of the animals. The hooks are placed on the posterior appendages of the several genera, and are so directed that the animals can pull themselves backwards; and when they are

* There can be little doubt that *Erichthoneus* of Edwards is synonymous with *Cerapus* of Say, and, according to Dana's figures, the genus *Pyctilus* also. The female of *Cerapus* bears a much nearer resemblance to *Podocerus* than to its male,—a circumstance that had led me to describe a female *Cerapus,* in the 'Synopsis of the British Edriophthalma,' as *Podocerus punctatus* (having never seen the male); it agrees closely with Leach's specimen of *Jassa punctata* in the British Museum.

situated upon the antennæ, they are so arranged that they can pull themselves forwards. The antennæ in *Podocerus* and *Cerapus* are, from their structure, evidently used as organs of prehension; and useful they are, no doubt, in their excursions through the tangled maze of numerous zoophytes and forests of weed that hang around the floating masses where they mostly love to dwell.

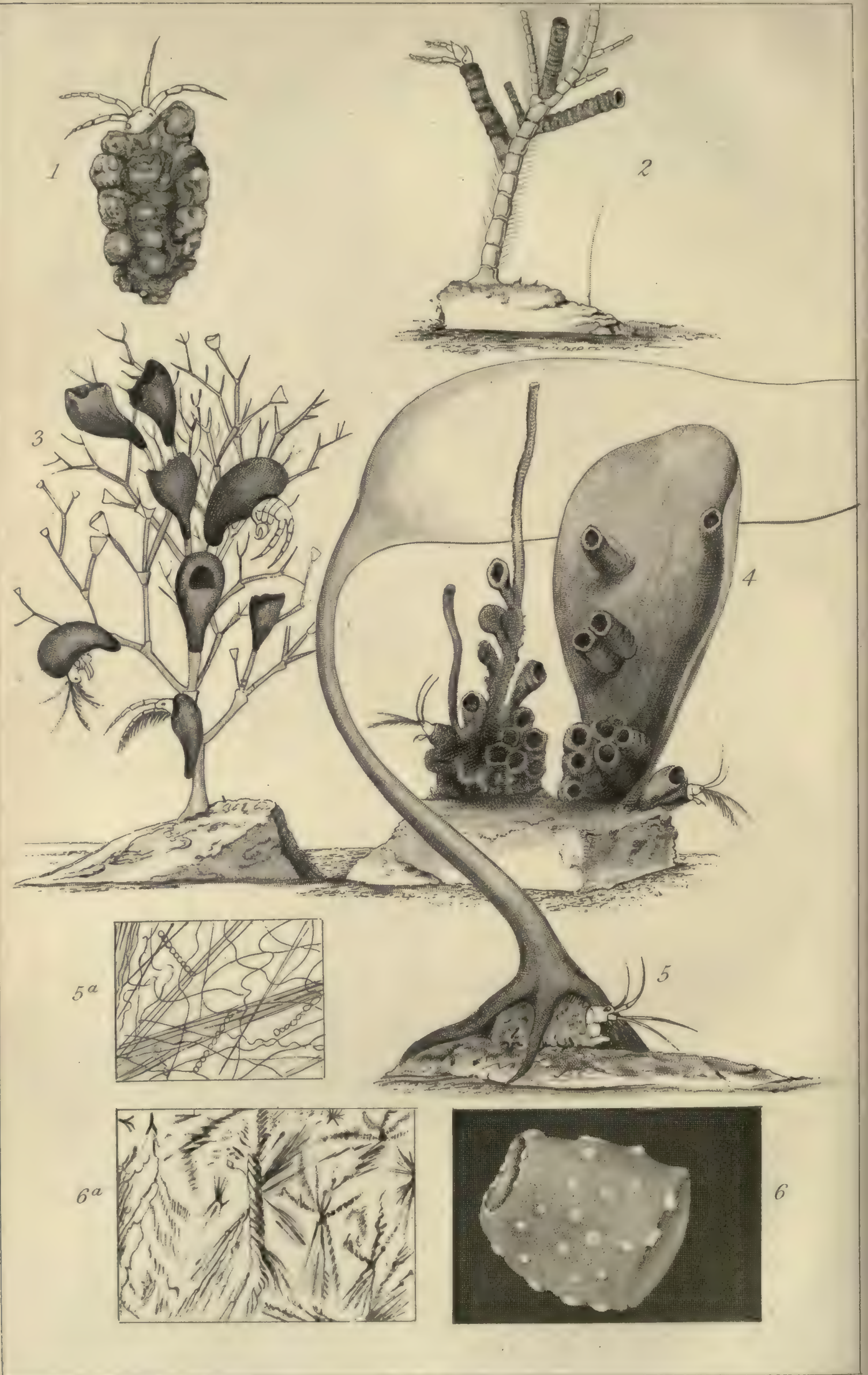
There can be little doubt, I think, that the hooks at the posterior extremities of the animals enable them to retire into their cases, and to turn round when they are within, which they do with a celerity that is noticeable.

Those Amphipoda that inhabit hollows which they make by burrowing into wood, clay, &c., such as *Corophium* and its near allies, exhibit a marked distinction in their formation: they penetrate by the aid of their anterior limbs. Thus we see the inferior antennæ developed into powerful (sometimes monstrous) organs, and used for breaking down the mud into which they excavate, for the purpose, it is supposed, of feeding upon the worms that dwell within it. In proportion to the power given to the anterior part, by so much does the posterior appear to be enfeebled. The posterior pleopoda in *Corophium* and *Unciola* lose their importance, and in *Cyrtophium* become rudimentary.

The distinct characters exhibited in the structure of this latter subfamily (*Corophiides*) are of such importance, that it is impossible to class the animals in the same group with *Podocerus*, although there are certain similar features in their habits which have induced authors to place them nearer to each other. Habit alone cannot be trusted to define the position of an animal in relation to its connexion with others of its class.

Of this we have examples in *Chelura* and *Phronima*. The former, like *Corophium*, burrows for food, but instead of penetrating into mud, eats its way into submarine wood; but its structure is so anomalous when compared with others of its class, that every naturalist has thought it desirable to place it in a family by itself.

With regard to *Phronima* our knowledge is small: its habit is that of an inhabitant of the gill-cavities of some one or more species of *Medusa*; but in the Collection of the British Museum entrusted to my care for examination is a very curious case that was sent home from Naples by S. P. Pratt, Esq., as being the one in which the animal was taken (Pl. VIII. fig. 6). The structure is thick, fleshy, semitransparent, and studded over the surface and round the two orifices—one of which is smaller than the other—with numerous white excrescences. Examination with the microscope (fig. 6 *a*) shows the substance to be pervaded by bundles



J. Basire, sc.

of fibres; each fasciculus is twisted together near its centre; these, some of them being larger than others, star the structure thickly, and still more plentifully where the white excrescences appear.

I am not prepared to state that this case was built by the animal, and some have suggested that it may be one of the *Medusæ*; but the microscopic structure appears to negative this latter idea.

That it is the nest in which the animal dwelt appears certain, but how it was constructed we have no information to guide us; still it is not at all improbable that there are many processes in the lower forms of life that have not yet been made known, some of which may be even more astonishing than the supposed fact, that an animal whose constant habit is to dwell within the protecting walls of another, can, upon being expelled by accident from its usual abode, secrete a substance that will protect it from external injury, and, as far as may be, fulfil the conditions of its normal position.

EXPLANATION OF PLATE VIII.

Fig. 1. Case of *Siphonocetus typicus*, enlarged (after Kröyer).
Fig. 2. Tubes of *Siphonocetus crassicornis* on *Antennularia*, enlarged.
Fig. 3. Nests of *Podocerus pulchellus* on *Laomedea*, enlarged.
Fig. 4. Nests of *Podocerus fucicola*? on *Ulva* and *Tubularia*.
Fig. 5. Nests of *Amphitoë rubricata* at the root of *Laminaria*.
Fig. 5 *a*. Microscopic structure of the same.
Fig. 6. Supposed nest of *Phronima*.
Fig. 6 *a*. Microscopic structure of the same.

XVII.—*Description of a Lacustrine Bryozoon allied to* Flustra. By H. J. Carter, Esq., H.C.S. Bombay.

[With a Plate.]

The following is a description of a polypidom which was sent to me by the Rev. S. Hislop, who found it for the first time in April last, growing plentifully on *Paludina Bengalensis* and the stems of aquatic plants, in a freshwater tank and adjoining well at Nagpoor, in Central India. So far as I am aware, it will form the first on record of a freshwater species of this kind of Bryozoon; and being encrusting and without calcareous matter in the skeleton, it will also afford the type of a new genus at least, for which I propose the name *Hislopia*, in honour of the reverend gentleman above mentioned, to whose acute observation and intelligence we are indebted not only for its discovery, but, in conjunction with his late colleague, the Rev. R. Hunter, for

those of fossil remains as yet unparalleled in interest and number in Indian geological research.

It differs from *Flustra* in the form and arrangement of the cells, and in not being erect; and from *Membranipora* and *Lepralia* in not being calcareous; but it agrees with *Flustra* in the latter character, and with *Lepralia* in being decumbent,—especially with that subdivision which has oral spines without other external appendages.

Fortunately the wet specimens that have reached me have arrived in a condition sufficiently preserved to admit of my describing, with the polypary or skeleton, the animal also, which, under the designation of *lacustris*, will stand as follows:—

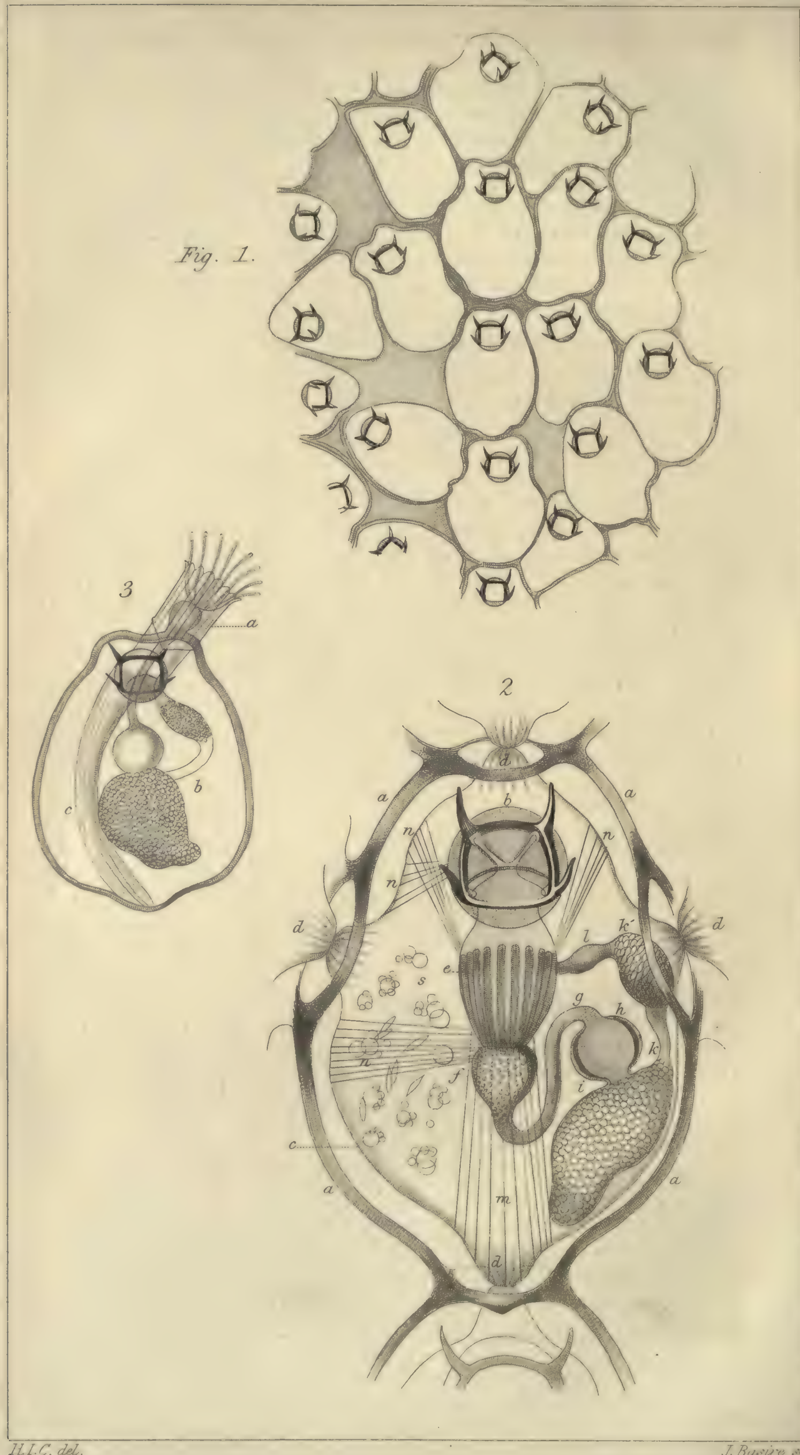
Hislopia lacustris, H. J. C., n. sp. Pl. VII. figs. 1–3.

Polypary kerato-membranous, without admixture of calcareous matter. Cells irregularly ovate, compressed, spreading in aggregation over smooth surfaces, sometimes linearly, but for the most part with no definite arrangement. Aperture subquadrangular, supported on a circular neck, closed by four triangular valves, of which the posterior is the largest, and partially overlaps the rest; surrounded by a horny raised border, from the angles of which respectively four spines project; posterior border less prominent than the rest, which permits of an almost uninterrupted continuation between the larger valve or lip and the membranous portion of the cell. Margin of the cell horny, pierced by 2–4 stoloniferous holes. Average greatest length and breadth of the cell 1-29th and 1-38th of an inch respectively.

Hab. Freshwater tanks which are never dry, on *Paludina bengalensis* and the stems of aquatic plants.

Loc. Nagpoor in Central India.

Animal.—Contained in a membranous sac, which lines the cell, and communicates with 2–4 adjoining cells by stolons through the holes mentioned: viz. posteriorly with the mother-, and anteriorly and antero-laterally with 1–3 daughter-cells. Mouth triangular, bordered by the valves mentioned, leading into a delicate, transparent, buccal sheath, plaited anteriorly, at the bottom of which (when inverted) is the orifice of the throat surrounded by 16 (?) tentacula. Pharynx pyriform, presenting a layer of cells or follicles internally, extending to the commencement of the œsophagus, which is narrow, long, and bent upon itself. Œsophagus followed by a dilated, globular portion, called the 'gizzard,' which is thick-coated, presenting two linear, horny bodies internally, and opening



H.I.C. del.

J. Basire sc.

by a wide mouth into the pyloric half of a large irregularly ovoid stomach. Stomach lined or surrounded (?) throughout with a layer of hepatic (?) cells, and contracted towards its pyloric end, where it is in continuation with the small intestine. Small intestine short, followed by a globular, sometimes elliptically dilated, portion (corresponding to the large intestine of higher animals (?)), also lined or surrounded with cells, but differing in appearance from those of the stomach; terminating in a contracted, rectal portion, which opens into the buccal sheath (when inverted). Retractor muscle attached to the posterior extremity of the cell, and around the posterior part of the buccal sheath (when inverted).

Obs.—Besides the retractor muscle, there are of course many others which pass from the lining membrane of the cell, and probably the cell itself, to the different visceral organs; but the torn state of these, from the contracting effect of the spirit in which the polypidom was preserved, prevents my describing and delineating them accurately. The peritoneal cavity, too, in most instances contained bunches of globular cells of different sizes, and some fusiform bodies, which might have been procreative elements; but not having observed them in their living state, I am unable to add more respecting them. I could discover neither testicle nor ovary; nor have I been able to make out the exact number of the tentacula, for the same reason. The latter, however, with their delicate buccal sheath, being in different degrees of extrusion in several of the cells respectively, it was easy to see that the plaited part preceded the extension of the tentacula, as in the other freshwater Bryozoa, and in *Bowerbankia*, to which latter the organology generally, as well as closely, corresponds.

EXPLANATION OF PLATE VII.

Fig. 1. *Hislopia lacustris,* polypary, proportionally magnified. Natural size of cells 1-29th of an inch long.

Fig. 2. Ditto, ditto, with animal, ditto, showing *a, a, a, a,* margins of cell; *b,* aperture closed by three valves, supported on a circular neck, surrounded by a horny border bearing four spines; *c,* lining membrane; *d, d, d, d,* stolons passing through their respective holes; *e,* buccal sheath enclosing tentacula; *f,* pharynx; *g,* œsophagus; *h,* gizzard; *i,* stomach; *k,* small intestine; *k'*, large intestine; *l,* rectum; *m,* retractor muscle; *n,n,n,* other muscles; *s,* spherical and fusiform cells.

Fig. 3. Ditto, ditto, ditto, with tentacula and buccal sheath partly extruded: *a,* buccal sheath, showing the plaited portion; *b,* visceral organs drawn up towards the aperture; *c,* retractor muscle, also extended.

Bombay, 9th Jan. 1858.

XVIII.—*On the Chylaqueous Fluid in the* Actinoida. By P. H. Gosse, F.R.S.

To the Editors of the Annals of Natural History.

Sandhurst, Torquay, Feb. 12, 1858.

Gentlemen,

In the 'Sea-side Studies' of Mr. G. H. Lewes, the statement is made, as the result of careful experiments, that the Sea-Anemones are totally destitute of any organized fluid answering to blood. His declarations on this head are full and clear. "This animal is not only without 'blood,' in any proper sense of the term, but also without that simpler form of blood named 'chylaqueous fluid' by Dr. Williams and succeeding writers." "No such fluid circulates in the Actiniæ,—an assertion which can readily be tested. The water is easily forced out of the tentacles, or collected by cutting open the Actiniæ in a glass. Evaporate it, and you will find it to be sea-water holding sometimes organic particles in solution. Test it with concentrated nitric acid, and instead of becoming turbid, as it would if it contained albumen in solution, it remains unaltered, except that when organic particles are present, they become distinct. Examine the fluid with the microscope, and you will find animalculæ and various particles, but nothing like definite corpuscles, such as are visible in the true chylaqueous fluid. It is, in short, sea-water, and nothing more*."

Doubting his own correctness, Mr. Lewes had recourse to Mr. R. Q. Couch, who undertook to repeat the investigation. The latter gentleman, with a power of 300 linear, examined, on repeated occasions, specimens of *Actinia mesembryanthemum*; but could discover in their contained fluid "nothing organic; and [except in one instance] it gave no cloudiness by nitric acid." The exception is, that in one case the water from the tentacles, when treated with nitric acid, "had a slight opalescent deposit, or rather, a diffused milky cloud of very slight character." This occurrence did not prevent Mr. Couch from regarding "this fluid as merely sea-water, free from every admixture of secreted matter." And a similar occurrence of the slight milky cloud, once, and only once, in Mr. Lewes's observations, he notices, as "showing that it arose from an accidental, not a constant element†."

Mr. Lewes rightly presumes that his physiological readers will receive this statement "with surprise," and that it will even "startle" them. It so far surprised me, that I at once set about

* Sea-side Studies, p. 257.
† *Op. cit.* pp. 257, 258.

testing its correctness; and I now send you the following results of my experiments.

I should premise, that in each of the following examples the fluid was taken from the animal *out of water*; either, as in the case of *A. mesembryanthemum*, one that had stationed itself at the surface, so that its body was partially exposed and dry; or one that became so exposed by a slight tilting of the vessel; or one that was taken out of the water. In all cases, the surface was carefully wiped with a soft linen cloth, to remove the external sea-water. The fluid was then obtained by making with a lancet an incision through the integuments, and by taking up the flowing liquid by means of a pipette, which, in some cases, needed to be inserted into the wound, before capillary attraction would induce the *liquor vitalis* to flow up.

The drop thus obtained was then deposited in an aquatic stage-cell, and flattened by means of the thin-glass cover. It was then submitted to a power of 600 linear under one of Powell's microscopes, the measurements being made with one of Jackson's eye-piece micrometers. Afterwards its albuminous character was tested by the addition of a minute quantity of nitric acid. The pipette was scrupulously cleansed, between the experiments, by repeated injections of fresh water, and all the instruments used were similarly washed and wiped.

Actinia mesembryanthemum.—The fluid was rather thinly studded with organic corpuscles; nearly circular in form, smooth and well defined in outline, delicately granulose in texture, and pale yellow in colour. They varied in dimensions from ·0002 inch to ·0007 in diameter; but the great majority averaged about ·0003. A drop of the same fluid spread on a slip of glass was perfectly hyaline; but, on nitric acid being added to it, it became distinctly milky.

Anthea cereus.—Corpuscles moderately numerous; mostly circular, rarely oblong, and drop-shaped; of a clear pale yellow hue; granulose; dimensions from ·0001 to ·0003, average ·0002 inch. With nitric acid, milkiness barely perceptible.

Sagartia parasitica.—Similar corpuscles, but far fewer and smaller; dimensions varying from ·0001 to ·0003, the majority about ·00015. With nitric acid, the milkiness was very slight, but perceptible.

Sag. nivea.—Corpuscles abundant, clear pale yellow; not *apparently* granular; more highly refractive than the surrounding fluid*; irregular in shape and size, but for the most part ovate or elliptical, averaging about ·0008 inch in longer dia-

* This character is not intended to be distinctive of this species; I believe it marked the corpuscles in all cases; but it was in this example that I first tested it by *focusing*.

meter by ·0003 in shorter. Treated with nitric acid, the drop immediately and strongly coagulated.

Sag. bellis.—Corpuscles moderately few; remarkable in general for the perfect circularity of their figure; from ·0001 to ·0003 inch, but for the most part attaining the latter measurement. Under nitric acid, a milkiness very slight, but perceptible, was produced, much as in *S. parasitica.*

Bunodes clavata.—Corpuscles rather sparsely scattered; varying much in size, from ·0001 to ·0008 inch, but averaging ·00025; their form roundish; their appearance (as usual) pale yellow, granulose; and the larger ones contained oil-globules.

Bunodes crassicornis.—Corpuscles very few and remote; nearly round; clear pale yellow; not evidently granulose; averaging from ·00015 to ·00025 inch. With the addition of nitric acid, no milkiness was produced that I could with confidence pronounce as such.

This specimen of *B. crassicornis,* after having been wiped dry with a cloth, I allowed to lie in a saucer without water for half an hour, and then tapped it a second time. I wished to ascertain whether the fluid contained within the body at any given moment, would or would not become more organized, if allowed to remain without communication with the sea-water. The fluid was now, as I had anticipated, very rich in morphotic elements, being *densely crowded* with corpuscles having the same character and average dimensions as those I had found at first. There was, moreover, a very marked coagulation, under treatment with nitric acid.

Yet again; having taken this Anemone from the saucer, I found about a quarter of a teaspoonful of fluid where it had lain, which had drained from it during the forty minutes that had elapsed since I had taken it from the tank. I examined a drop of this fluid. Though not quite so full of morphotic matter as that last taken from the animal, it was still richly corpusculated; and, on the addition of nitric acid, coagulated *strongly.*

But were not these exceptional cases? Have I not selected for record a few samples in which I succeeded in finding organized elements, cushioning the many in which I failed? No: I have given the results of every case that I examined. The specimens were taken at random, and yielded the same undeviating result. There was not a single exception.

Having thus found corpuscular elements in the chylaqueous fluid of the above seven species, of four genera, I next set myself to examine the water of the different vessels in which the animals had lived. These tanks and vases were five in number. A drop of water, taken from each of these in succession,

and separately examined, proved absolutely free from the corpuscles that I had found in all the Anemones, with this doubtful exception: I found in one drop a single solitary corpuscle. But the presence of that one might safely be attributed to the fact, that I had previously returned one of the wounded animals to the vessel in question, and from this individual it had probably escaped.

Mr. Lewes suggests that possibly his predecessors in research had mistaken for blood-elements "the yellow spherical cells (?) which fill the tentacles of the adult Daisy, and make solid the tentacles of the *Anthea*." Of the function of these yellow spheres he confesses himself ignorant. The supposition is untenable. These spherules are pigment-cells, and they do not fill, far less make solid, the tentacles, but merely line their interior. These pigment-cells occurred in several of the experiments recorded above, and especially in the fluid obtained by incising the body of *Sagartia bellis*; but there is no possibility of confounding these with the morphotic corpuscles of the chylaqueous fluid: they differ notably in size, colour and structure. The corpuscles (in *Anthea*) average ·0002 inch in diameter; the pigment-cells are fully double this size: the corpuscles have a very faint yellow tinge, *seemingly* disks rather than spheres, with no definite walls, and composed of granulose substance; the pigment-cells are of a full but translucent golden-brown hue, very regularly globular in form, evidently spheres, and with a distinct wall.

It is not with any feeling of disrespect to either of the gentlemen named, that I forward these results for publication in the 'Annals.' The subject in question is one of considerable physiological importance; and as diametrically opposite conclusions have been arrived at by independent observers, and as it must be settled by the weight of testimony, I have thought it well to add my mite of evidence in favour of the affirmative side.

I am, Gentlemen,

Yours faithfully,

P. H. Gosse.

XIX.—*On the Formation of the Egg and Fertilization in the* Nematoidea. By Edouard Claparède*.

The dispute between Nelson, Bischoff and Meissner with regard to the formation and fertilization of the eggs in *Ascaris mystax*, has not yet attained any satisfactory solution. Not one of these three observers has retracted anything of his previous statements,

* Translated from Siebold and Kölliker's Zeitschrift für wissenschaftliche Zoologie, vol. ix. p. 106, by W. S. Dallas, F.L.S.

and each seems rather to assert positively that the right is on his side. It is to be regretted that the strife has not always been kept within scientific limits, and that passion has too often been allowed free play. By this means errors have certainly been produced, which otherwise might never have arisen.

A communication upon the subject in question has recently been published by Allan Thompson*, in which the author quietly considers the disputed points, and explains them with great accuracy. We regard this memoir as the best that has appeared upon the fecundation of *Ascaris mystax*. Thompson, a friend of Nelson's, has borne himself as impartially as possible in the discussion; nevertheless, a confirmation of statements by another likewise impartial observer might not appear to be undesirable, especially as Thompson was not acquainted with Schneider's observations upon the movements of the spermatozoa in the Nematoidea, and consequently has not referred to them. But if these observations be generalized, and if we assume that the *Amœba*-like movements of the zoosperms occur in all Nematoidea, it might seem improbable that the thimble-shaped corpuscles, which have been described as the seminal corpuscles of *Ascaris mystax* by Nelson, Meissner and Thompson, are the true zoosperms. These corpuscles have such a constant form, that we cannot well understand how they should move like *Amœbæ*, unless the extension and retraction of processes be limited to the flocculent end of the corpuscle.

1. *Histology of the Sexual Tube.*

It is above all things necessary to investigate the tissues occurring in the sexual tube of the Nematoidea more accurately, to enable us to decide the question whether epithelial structures occur, which do or do not agree with Bischoff's epithelial conules.

In the female the sexual tube consists of a membrane which is, at all events apparently, perfectly structureless. That its blind extremity consists of a series of cells fused together, as has been represented by Kölliker†, is certainly an error, the origin of which Reichert‡ has rightly sought for in phænomena of diffusion. The blind extremity is not unfrequently much thickened. A thickening of this kind occurs almost constantly in *Cucullanus elegans*, in an undetermined *Ascaris* from the small

* Zeitschr. für wiss. Zool. vol. viii. part 3.

† Beiträge zur Entwicklungsgeschichte wirbelloser Thiere. Müller's Archiv, 1847.

‡ Beitrag zur Entwicklungsgesch. der Samenkörperchen bei den Nematoden. Müller's Archiv, 1847.

intestine of *Triton tæniatus,* &c. Sometimes we have found the posterior extremity of the germ-stock very considerably thickened also in *Ascaris mystax.*

This structureless *tunica propria* is clothed upon the surface turned towards the lumen with an epithelium, as has already been described by Lieberkühn, Schneider, and Meissner in various Nematoidea. In most species this epithelium is very distinct in the vagina and uterus; its detection is more difficult in the oviduct and vitellogene. In the upper part of the latter and in the germ-stock we have been unable to discover an epithelial coat in any single Nematoid worm. Lieberkühn, also, who has accurately described the distribution of the epithelium in a worm from the proventriculus of *Fulica atra* and *Anas Boschas domestica**, has never been able to trace it to the uppermost part of the sexual tube.

In one species of *Ascaris* we have met with a form of epithelium, which, at the first glance, appeared to be in favour of Bischoff, in his dispute with Nelson and Meissner. This is the *Ascaris suilla,* from the intestine of the Pig. In this *Ascaris* the uteri as well as the oviducts are lined with large epithelial cells, 0·10 to 0·18 millim. in breadth, each of which is furnished with a process of 0·018 to 0·027 millim. in length, which projects into the lumen of the tube. The process is about as broad as long. It cannot be denied that there is a considerable resemblance between these processes and Bischoff's epithelial conules, except that the former are a good deal larger. But the *Ascaris* of the Pig is considerably larger than that of the Cat. The processes and conules, however, differ from each other in many respects. The latter only adhere very loosely to the wall of the genital tube, whilst the former are firmly attached to the epithelial cells; they are formed by a prolongation of the cell-membrane, and cannot be stripped off in any way. Most of Bischoff's epithelial conules are found free in the tube of *Ascaris mystax,* in consequence, we are told, of the weakness of the original union. But we could not succeed in separating the processes of *Ascaris suilla* from their foundation. Lastly, we have to mention one circumstance which sufficiently proves that the processes and conules have nothing to do with each other. In certain female individuals of *Ascaris suilla,*—and indeed, as we shall see hereafter, in the unfecundated individuals,—not only the processes of the epithelial cells, but also Bischoff's epithelial conules occur. The latter are considerably smaller than the processes, and it was impossible to detect any relation between them and the epithelium.

Meissner has already mentioned a villous epithelium in *Ascaris*

* Beiträge zur Anatomie der Nematoden. Müller's Archiv, 1855.

megalocephala, which is probably very similar to the above-described epithelial coat in *Ascaris suilla.*

In *Ascaris mystax* the epithelium presents nothing of the kind; it is rather perfectly smooth, and Nelson* has described and figured it very accurately. Notwithstanding the opposite statements of Bischoff and Leuckart, we have been unable, any more than Nelson, Meissner, and Thompson, to convince ourselves that the so-called epithelial conules ever adhere to the wall.

The outer surface of the *tunica propria* is clothed with a contractile layer in the lower part of the genital tube. In many species (*Ascaris suilla, A. mystax, Oxyuris vermicularis,* &c.) this layer consists of readily perceptible muscular fibres. In other species it appears to be perfectly structureless or simply granular, as Meissner has already remarked with reference to the uterus of *Mermis nigrescens* and various species of *Gordius.* Sometimes, however, as, for example, in *Cucullanus elegans,* an indefinite arrangement of the granules in transverse rows may be detected, from which we may very easily be led to suppose that these rows of granules represent difficultly visible muscular fibres. It was nevertheless impossible to prove the existence of these supposed muscular fibres by means of reagents.

Lastly, we should mention the granular longitudinal folds of the vitellogene in *Ascaris mystax,* which also occur in *A. suilla.* But as Nelson has connected these folds with the yelk-formation, we shall pay attention to them when we come to speak of the formation of the yelk.

The male genital tube is exactly of the same histological nature as that of the female, except that in the male *Ascaris suilla* the processes of the epithelial cells are wanting. In an *Ascaris* from the intestine of *Lota vulgaris,* which we regard as *A. mucronata,* the muscular layer consists of fusiform cells, which resemble the smooth muscular cells of the higher animals. Each cell is furnished with a nucleus of as much as 0·016 millim. in diameter, containing numerous nucleolar corpuscles. The portion of the male genital tube of *Ascaris suilla* which corresponds with the vitellogene of the female, is, like the latter, provided with granular longitudinal folds.

We will also mention that from three to four large oval cells occur at the base of the spicula in certain Nematoidea. Their signification is still perfectly problematical. Perhaps they must be regarded as simple glands. Such cells were found, for example, in *Ascaris suilla,* in which they even attain a length of 0·23 millim. In *Ascaris mucronata* they are about 0·18 millim. in length, but slender. According to an oral communication

* Reproduction of *Ascaris mystax.* Phil. Trans. part ii. 1855.

from Dr. Guido Wagener, he has also detected similar structures in various Nematoid worms.

2. *Formation of the Eggs.*

The Nematoidea may be divided into two sections as regards the mode of formation of the eggs. One of these sections includes those species whose eggs are arranged round a central rhachis in the vitellogene; the other is formed by those species which possess no rhachis. As a general rule, it may be asserted, that all the Nematoidea in which the vitellogene exhibits several eggs in the same transverse section, belong to the first category; whilst those in which each transverse section only hits upon a single egg, are to be referred to the second. We shall occupy ourselves especially with the species of the first section. Here we again meet with the *Ascaris mystax*, at once so celebrated and notorious, and with it the *Ascaris suilla*. We shall select the latter in preference as the subject of our investigation, as it is better adapted for this purpose than the former. The rhachis is much thicker in it than in *A. mystax*, and shines through the walls of the organ in the axis of the vitellogene, in the form of a dark column.

Like Bischoff and Thompson, we have been unable to find Meissner's female germ-cells. The germ-stock is full of vesicular elements, which subsequently become the germinal vesicles of the eggs in course of formation. But no appearances which might have been in any way favourable to Meissner's view, were ever observed. It is true that the mode in which the germinal vesicles are first produced could not be ascertained, and we only consider it probable that they increase by division. We think we must contradict Nelson's statement, according to which the germinal spots are first produced, and subsequently surround themselves with a membrane to form the germinal vesicles.

As the germinal vesicles descend in the genital tube, they surround themselves with a granular substance, the first rudiment of the yelk. At the point where this deposit first takes place, the vitellogene properly begins. There is, however, no true boundary between the germ-stock and vitellogene. Even in the so-called germ-stock the germinal vesicles are united to each other by a tenacious transparent substance, which is nothing but the first commencement of the yelk-deposit. Within this tenacious fundamental substance, small granules gradually make their appearance,—these are the first yelk-granules, which soon become so extremely numerous that it is no longer possible to recognize the germinal vesicle. The contents of the ovarian tube then appear uniformly granular. When the tube is cut

through, the contents flow forth in the form of a coherent mass. If we now examine a portion of the tube situated rather lower down, we find larger granules arranged in the axis of the organ. These form the first commencement of the rhachis, which gradually becomes broader and darker, whilst the periphery of the contained mass appears mamillated. When the genital tube is torn up with needles, this contained mass is observed to consist of pyramidal eggs, of which the apices adhere to the rhachis, whilst their bases form hemispherical elevations at the periphery. The question now is, whether this rhachis be a true one, or only apparent, as Meissner asserts. The rhachis is a true one; upon this point there can be no doubt. In *Ascaris suilla*, in which the rhachis is very thick, it is easy, by means of needles, to strip off most of the eggs from the rhachis, and obtain long pieces of the latter in a free state. We may then convince ourselves that the rhachis really forms a continuous column, and that it does not consist of a series of germinal cells. In *Ascaris mystax*, in which the rhachis is much thinner, this preparation does not certainly succeed so easily; but here also the conditions are exactly the same. Both in *Ascaris mystax* and in *A. suilla*, but especially in the latter, it is easy to obtain the stellate groups of eggs which Meissner has figured and described as germ-cells with eggs adhering to them. These, however, are mere artificial productions, which may be prepared at pleasure by tearing away small pieces of the rhachis. It is very remarkable that Meissner, although he discerned this circumstance very accurately in *Strongylus armatus*, nevertheless still maintains his perfectly false theory.

Bischoff and Meissner have disputed gallantly as to whether the eggs are or are not furnished with a vitelline membrane within the vitellogene. In our opinion, however, this is a trifling dispute, which has already cost far too many words, but has thriven to such an extent, that it must cost a few more. It might have been desirable that the combatants, before arming themselves for the battle, had first ascertained clearly what they understood by *membrane*. This is a notion that forces itself upon us involuntarily when we read Thompson's memoir. This observer denies* the existence of the membrane, because the surface of the eggs appears exactly like that of a Proteus (*Amœba*). But the difficulty is by no means got rid of in this way, for there is no question so unsettled at present, as that of the presence or absence of an enveloping membrane in the *Amœbæ*. It is only recently that Auerbach† has brought forward reasons in

* *Loc. cit.* p. 435.

† Ueber die Einzelligkeit der Amœben. Zeitschrift für wiss. Zool. Bd. vii. Heft 4.

favour of its presence. Supposing, therefore, that Auerbach's opinion be correct, Thompson's observation would no longer tend to support Nelson, but would rather speak unexpectedly in favour of Meissner.

A membrane is a thin layer of a substance, the chemical or physical properties of which (tenacity, firmness, density, &c.) are sharply distinguished from those of the media in contact with it on both sides. The periphery of an *Amœba* is undoubtedly formed by a layer of greater density than the rest of the parenchyma of the body. But it seems not improbable that the parenchyma increases gradually in density from within outwards, and that the external denser layer is not clearly defined towards the inner, softer parenchyma. In this case no true membrane is present. We can only speak of a denser layer or region. Mohl has already noticed this condition in plants, and distinguished every dense outer layer, which cannot be clearly separated from the inner substance, by the name of *pellicula,* in opposition to the idea of a *membrane.* The term pellicula is perhaps not very happily chosen.

In our opinion, the eggs of *Ascaris mystax* and *A. suilla* are in this respect in the same condition as the *Amœbæ.* We have to distinguish two different things in the yelk,—in the first place the vitelline granules, and then a transparent, colourless, uniting, intermediate substance. The outer layer of the eggs is formed only of the latter; no vitelline granules are contained in it. Of this layer Meissner has made his vitelline membrane. It is, however, as already stated, not a membrane, but only the intermediate substance, becoming more and more dense externally. It is just because this intermediate substance has a greater density at the periphery, that the vitelline granules do not penetrate into the outer layer.

All observers agree that the eggs are surrounded by a membrane in the lower part of the tube. This membrane is produced by the outer granule-less layer of the yelk becoming sharply defined in opposition to the interior of the egg. But where the differentiation commences, it is difficult to say. For this reason Bischoff may, to a certain extent, be right in asserting, that the eggs in the vitellogene are not surrounded by a membrane, as the membrane is not yet perceptibly differentiated from the yelk. On the other hand, Meissner is not quite in the wrong in maintaining the presence of the membrane, as it is already in course of formation. Whilst, according to Meissner, the vitelline granules are formed in his supposed germ-cells, Nelson and Bischoff, on the contrary, see the place of formation of these granules in the granular longitudinal processes of the vitellogene. Thompson, who supposes that the deposition of the vitel-

line substance takes place from without, proceeds more cautiously, and does not venture to decide in any way as to the place of formation of the vitelline granules. We do not believe that the vitelline granules can be formed by the longitudinal processes, because free vitelline granules never occur between the wall of the genital tube and the column of ova. Moreover, the granules would have to penetrate first of all into the outer granule-less layer of the yelk, if the deposition took place from without; but nothing of the kind is observed. It is not to be doubted that in the upper part of the genital tube the granules are formed all round the germinal vesicle; but as soon as the rhachis makes its appearance, it seems to us that this must be considered as the place of formation of the vitelline granules. It is (in *Ascaris suilla*) comparatively very broad and densely filled with vitelline granules; more densely, in fact, than the eggs themselves. In the lower part of the vitellogene, at the point where the eggs separate by constriction, the rhachis disappears. What, then, has become of its contents? They have passed into the corresponding ova; and we believe that every new vitelline granule that appears in an egg has come over from the rhachis. This view does not differ much from that of Meissner. In either case, the vitelline granules are produced in the rhachis; but in the one case the rhachis is real, in the other apparent.

The question of the micropyle in the ova of the *Ascarides* is one of great importance, as Meissner's theory of fecundation entirely depends upon it. A micropyle, such as is described by Meissner—that is to say, an aperture in a membrane—certainly does not exist, as we cannot detect any true membrane. Meissner's theory is not, indeed, compromised by this, as a fissure in the external, denser, vitelline layer might very well perform the function of a true micropyle. But we cannot admit the micropyle even in this limited sense. The ovum gradually separates itself from the rhachis by constriction, so that the bridge of connexion between the two becomes thinner by degrees, and at last disappears. There then remains no fissure in the outer layer, but the place of the pretended micropyle is clothed, like the rest of the egg, with this layer.

The changes which the egg undergoes in the lower part of the oviduct will be referred to hereafter, at the same time with the fecundation.

Amongst the Nematoidea in the vitellogene of which a rhachis is to be met with, we shall also mention *Cucullanus elegans*. Siebold, even in his 'Comparative Anatomy,' places this worm amongst those which have a rhachis in the vitellogene, but says nothing further upon it. It must therefore appear strange that

the two authors who have studied the eggs of *Cucullanus elegans* most in detail, namely Kölliker* and Gabriel†, do not say a word about a rhachis. The blind extremity of the tube of the ovary in *Cucullanus* is filled with clear vesicles,—the germinal vesicles with their germinal spots. Between these vesicles there is even there a transparent substance, by which they are enveloped. This is the first commencement of yelk-formation, and, with a little attention, we may already distinguish delicate lines, which bound the ovules. A distinction of germ-stock and vitellogene is therefore here practically quite impossible. That the germinal vesicles are destitute of germinal spots in the upper half of the ovary, as is asserted by Gabriel, is certainly not the case. This naturalist has even accused Bagge of error, because he stated that he observed the germinal spots in the germ-stock of *Strongylus auricularis* and *Ascaris acuminata*. But any one may easily convince himself of the correctness of Bagge's statement. On the other hand, we have not been able to confirm Kölliker's observation, according to which the germinal spots are produced before the germinal vesicles themselves.

As the eggs progress downwards in the genital tube, they increase quickly in diameter in consequence of the rapid formation of the colourless transparent yelk: they then form a coherent mass. When an egg is torn away from this mass, it is found to have a pyriform shape and a short thin stalk. By the careful treatment of the mass of eggs with needles, or by gentle pressure with the thin glass cover, the eggs may not unfrequently be separated, so that we may perceive how they form an elegant bunch. The bunch consists, as it were, of extremely thin, delicate branches, and thick berries. In the axis of the genital tube the little branches come together, and form a main stem, the rhachis, which is here very thin. As this rhachis and its branches are not only very delicate, but also, like the vitelline substance in *Cucullanus elegans*, colourless, they are not always easily perceptible. They become so immediately, however, when the bunches of eggs are coloured by solution of iodine.

We shall not speak here of those Nematoid worms in which the vitellogene always contains only a single series of eggs, as the egg-formation in these has already been sufficiently explained by Siebold and Bagge.

3. *Formation of the Seminal Corpuscles.*

With regard to the formation of the seminal corpuscles, we

* *Loc. cit.* Müller's Archiv, 1843.

† De *Cucullani elegantis* vivipari evolutione. Auctore Benno Gabriel. Berolini, 1853.

come at once upon a dispute, the counterpart of that which we have already referred to in connexion with the formation of the ovum. Some assert that the seminal corpuscles are from the first surrounded by a membrane; others will not admit the existence of this membrane. The principal supporters of the latter opinion are Siebold, Nelson, Bischoff, and Thompson. Reichert and Meissner hold the former. Here, again, the truth appears to lie in the middle, or, if it be preferred, on both sides.

The turning-point of the whole discussion is formed again in this case by *Ascaris mystax*. Unfortunately, we have had but few cats at our disposal, and in these we only found female *Ascarides*. As, however, we have obtained male individuals of *Ascaris suilla*, this deficiency is easily got over. The mature seminal corpuscles of the two species are so much alike, that it is perfectly impossible to distinguish them; we may therefore well suppose that the course of development will be essentially the same in both cases.

The blind extremity of the genital tube is full of small colourless vesicles. There can be no question about Meissner's male germ-cells. It was as impossible for us as for Nelson, Bischoff, and Thompson to find them, and it is not probable that they could have escaped so many observers. As the colourless vesicles progress downwards in the genital tube, they surround themselves with a granular mass, which consists of strongly refractive granules and a colourless connecting substance. The contents of the male genital tube are then perfectly similar to those of the vitellogene, and the more so as the seminal corpuscles in formation are of a pyriform shape, with their apices directed towards the axis of the organ. The apices adhere more or less to each other, but a true rhachis is not produced by this means. Each corpuscle now appears like an egg; the clear vesicle shines through, like a germinal vesicle through the yelk. This deposition of granules was first described by Siebold in *Ascaris paucipara*. It was, however, controverted, evidently incorrectly, by Reichert; but the latter observed *Strongylus auricularis* and *Ascaris acuminata*, in which the seminal elements are comparatively small. In *Ascaris paucipara* and *Ascaris suilla*, on the other hand, the various stages of development of the seminal elements are considerably larger, so that they permit observations to be made with much greater certainty.

In the lower part of the testis, the corpuscles which were previously pyriform, or rather pyramidal, become rounded; the nucleus (the clear vesicle) disappears altogether. Each corpuscle then forms a granular sphere. The granules soon pass to one particular side of the globule, so that it then represents a clear, transparent sphere, furnished with an aggregation of granules

at a certain spot in its periphery. This is the stage that corresponds with Meissner's mature germ-cells. The sphere then exhibits a very sharp outline, "a well-defined margin," as Nelson says. Nevertheless Bischoff here again denies the existence of a membrane, and calls the sphere a sarcode-globule. The question is a difficult one to decide. We should declare ourselves decidedly against the assumption of an enveloping membrane, so long as the deposition of granules around the original vesicle is still going on. But whether the outer layer of the spheres does or does not harden into a membrane in the lower part of the testis, or in the so-called *ductus deferens,* it is difficult to decide. We are inclined to believe that the same conditions occur here as with the ova in the vitellogene, and that the sphere gradually increases in density towards the periphery.

Nelson asserts that the nuclei (the original clear vesicles) of the corpuscles are persistent, so as to free themselves from their granular envelope within the female genitalia, and reappear as *spermatic cells.* This is certainly an error. The nucleus disappears very early, and no trace of it is then to be found.

Hitherto no further development of the seminal corpuscles in the male genitalia has been observed. The following stages have always been met with in the female sexual organs. We have, however, been more fortunate than previous observers, inasmuch as we have been able to trace the development of the seminal corpuscles further in the seminal sac of *Ascaris suilla.* After the clear globules with accumulations of granules have increased by division, they reach the seminal vesicle; they may then be regarded as development-cells of the zoospermia. From any point of the aggregation of granules there rises a small arched process, which gradually grows up into a finger-shaped body. We have not been able to observe that this process carries a membrane forward with it, by which the question of the presence or absence of the membrane might have been solved. The sphere rather separates very soon, so that the aggregation of granules with its attached finger-like body becomes free. It is not rare to meet with aggregations of granules which bear from two to four finger-like bodies, although we have been unable to ascertain that all these bodies originate from a single cell. It is possible that such groups are produced by several aggregations of granules adhering to each other, and as it were becoming amalgamated. However, we have never observed that the aggregations bearing several finger-like processes were larger than those which were furnished with a single one. Lastly, we find loose finger-like corpuscles, which are no longer adherent to the granular aggregations. These have the greatest resemblance to the thimble-like corpuscles, which are

found in the female genitalia (Bischoff's *epithelial conules*), except that they are rather longer. This difference, however, is of no consequence, if we consider that the thimble-like corpuscles of the female are furnished with a flocculent tuft at one extremity. Supposing that a small portion of the finger-like body acquires a flocculent nature, it will be impossible to distinguish it from a thimble-like corpuscle. No further development was observed within the male genitalia.

Bischoff has asserted that he has again met with his epithelial conules, although of a different form, in *Strongylus auricularis* and *Ascaris nigro-venosa*. In *Strongylus auricularis* the conical seminal corpuscles, first described by Bagge and Reichert, occur not only in the female, but also, in masses, in the male sexual organs. They were never observed adhering to the walls of the genital tube. The development of these corpuscles is rather complicated, and our observations upon it do not agree perfectly with those of Reichert. Reichert took up the idea that the parts of most zoospermia, namely the head and tail, are to be found in the seminal corpuscles of *Strongylus auricularis*, by which many errors have been produced. Such a comparison between these seminal corpuscles and the tailed zoospermia is inadmissible. In the latter the tail is the moving, and the head the passively moved part. We shall see hereafter that, when the seminal corpuscles of *Strongylus auricularis* begin to move, the part that moves is exactly that to which Reichert gave the name of the head, whilst the so-called tail is trailed along.

We shall content ourselves for the present with these observations, without entering upon a more exact description of the process of development of these seminal corpuscles. We shall only add, that the last stage of development which is met with in the males, forms bodies which may be compared with an elongated cone, or perhaps better, as the tips are usually bent round, with the horn of a chamois.

4. *Of the Fecundation.*

It is one of the most beautiful results of modern physiology that several observers have succeeded in proving, in various animals, that the penetration of one or more zoospermia into the ovum is the first condition of impregnation. It might, however, at present, be somewhat precipitate, if we were to set up the general proposition that no fecundation is possible without the direct penetration of the spermatozoon itself. We need only refer to the immense zoospermia of certain Salamanders, and especially to those of the species of *Cypris*, which are so uncommonly large, that they not only considerably exceed the egg, but

even the mature animal itself, in length. Such instances render it not improbable, that under certain circumstances it is not the spermatozoon itself, but only a portion of it, or an emanation from it, that takes part in the penetration.

Amongst the species in which the penetration of the zoospermia into the ovum has been observed, *Ascaris mystax* has occupied a leading place. It is now necessary that we should examine how far we may attach unconditional credit to the observations of Nelson and Meissner with regard to this penetration.

Two questions force themselves upon us: first, are the corpuscles, which, according to Nelson and Meissner, effect the fecundation, the true zoospermia? and, secondly, do these corpuscles actually penetrate into the egg; or, at least, are the observations of Nelson and Meissner upon their penetration decisive?

We have already indicated how we answer the first question. Upon this point we agree perfectly with Nelson and Meissner, and regard the thimble-like corpuscles as true zoospermia. It has already been shown that these corpuscles have nothing to do with the epithelium; but this by no means proves that they are in any way connected with the act of fecundation. In the elucidation of this question we have derived great advantage from the unfertilized females. All the females of *Ascaris mystax* that we have investigated were indeed fecundated, as could easily be perceived from the alterations which had taken place in the eggs. On the other hand, we have obtained more than twenty females of *Ascaris suilla*, in which the eggs did not exhibit the slightest alteration that could be referred to an influence of impregnation, and for this reason we have regarded these females as unfertilized. There were two females from the Pig, whose ova, to judge from the changes which they had already undergone, were evidently fecundated. It was remarkable that not one of the former *Ascarides* contained thimble-like corpuscles in their genitalia. In the two latter, on the contrary, the oviduct was closely filled with them. Our friend Dr. de la Valette has observed an exactly similar fact in *Ascaris mystax*. He found a female which, from the condition of the ova, he could not but regard as unimpregnated, and it did not contain a single thimble-like corpuscle. If, on the one hand, we bear these facts in mind, and, on the other, realize the extreme similarity which exists between the last stages of development of the zoospermia in the male sexual organs of *Ascaris suilla*, and the thimble-like bodies in question, we must be convinced that the latter are the true mature spermatozoa. That the sharply truncated extremity of the finger-like seminal corpuscle of the male acquires a floccu-

lent structure when this corpuscle reaches the female generative organs, and becomes the flocculent end of the thimble-like zoospermion, has not indeed been as yet observed directly. But the probability of this change becomes elevated into certainty by the fact, that we have directly observed an exactly similar process in the seminal corpuscles of *Strongylus auricularis*.

It is deserving of notice that these facts were not entirely unknown to Bischoff. He has had an *Ascaris mystax* in his hands the eggs* of which were to all appearance unfecundated, and its sexual organs also contained none of the so-called epithelial conules. Nevertheless, Bischoff firmly retained his opinion, and supposed that the conules were wanting because the female was immature. He thinks to find a proof of this in the fact that the eggs appeared quite otherwise than in other cases; the chorion was not granular as usual, but lamellose and thin. This is no proof; but nevertheless the observation is interesting, as we shall show immediately that in many Nematoidea the want of fecundation superinduces the formation of an abnormal chorion.

That the unfertilized *Ascarides* observed by us were not immature, is perfectly certain. Most of them were very large; many of them even very considerably exceeded the maximum of length to which this species is otherwise restricted.

The fate of the ova in *Ascaris suilla* is different, according as they are fertilized or not. We shall in the first place consider the fertilized egg.

As soon as the egg has passed the spot where the fertilization takes place, it surrounds itself with a distinct membrane. This is no new formation, no structure secreted from the tube; it rather appears to us that this membrane is only produced by a sharper differentiation of the outer denser layer which has already been referred to. At any rate, the formation of this membrane is no immediate consequence of fecundation, for it also occurs in the unimpregnated female. But in the latter this membrane appeared to be thinner and more delicate. Around this membrane a second is formed, the chorion, probably secreted by the walls of the genital tube. This chorion attains a considerable thickness, and is smooth on the surface. At the same time, a molecular change shows itself in the interior of the yelk. Before fecundation the latter was perfectly opake, and consequently appeared nearly black under the microscope. But after fertilization the vitelline granules gradually become less refractive, and the yelk thus appears paler and more transparent. At the same time a clear vesicle becomes visible in the midst of it.

In the unimpregnated female the egg does not properly sur-

* Ueber Ei- und Samenbildung und Befruchtung bei *Ascaris mystax*. Zeitschr. für wiss. Zool., February 1855.

round itself with any second membrane. In place of it there is a deposition of a thick layer of a flocculent, whitish substance, appearing something like loose cotton wool. This layer never solidifies into a true chorion. Between the eggs there are here and there loose lumps of this peculiar substance. Small refractive corpuscles are now and then lodged in them. These unfecundated eggs always remain dark, and never become clear; nor do they usually acquire such a regular oval form as the fertilized ones.

This action of the fertilizing corpuscles upon the formation of the chorion presents the more interest, as it reminds us of an exactly similar phænomenon in botany. Pringsheim*, as is well known, has discovered that the resting-spores of the *Vaucheriæ* lie first of all perfectly naked in the sporangium, and only surround themselves with a membrane when the spermatozoids have penetrated through the micropyle into the sporangium. Pringsheim† has made exactly similar observations in *Œdogonium*.

We cannot here omit again mentioning the unimpregnated *Ascaris mystax* which was observed by Bischoff, the eggs of which, according to the statements of this observer, possessed an abnormal, not granular, but lamellar chorion. Nelson had already called attention to a distinction in the structure of the chorion in the eggs of *Ascaris mystax*, according as they have or have not been fecundated. His statements, however, differ from those of Bischoff. He describes the chorion of his 'false,' that is to say, unfertilized eggs, as granular, whilst that of the fecundated eggs is perfectly smooth. Here we must declare ourselves decidedly in opposition to Nelson. The females of *Ascaris mystax* that were at our disposal were all impregnated, but in not one of them did the chorion appear smooth, but always exhibited a very distinct structure. With a strong magnifying power, this structure proved to be a delicate division of the surface into facets. The facets are of the form of watch-glasses, and slightly concave; they are visible both on the inner and outer surface of the chorion. They are larger or smaller according to the individuals. When they are very small, it is not easy to recognize what is before us, and we may then be misled into characterizing the structure as granular, or to suppose that there are very fine canals in the chorion. But whenever individuals are met with in which the facets are 0·004–0·005 millim. in breadth, no further doubt is possible. It must therefore

* Ueber die Befruchtung der Algen. Monatsbericht der Berl. Akad., March 1855.

† Monatsbericht der Berl. Akad. 1856.

remain uncertain whether Nelson's "false eggs" had really escaped fecundation.

It is by no means our intention to represent this influence of the act of fecundation upon the formation of the chorion as universal. There are Nematoid worms in which the eggs surround themselves with a perfectly regular chorion, even in the unimpregnated females,—as, for example, *Oxyuris vermicularis* and many others.

We have turned our attention particularly to the mode in which the fecundation is effected, but without being able to arrive at any positive result. Nothing, especially, could be discovered from which it might be concluded with some probability that the zoospermia penetrate into the yelk. It is a recognized principle that a positive observation cannot be subverted by a negative one; and for this reason we shall by no means declare the statements of Nelson and Meissner to be improbable. We may nevertheless be permitted to subject the investigations of both observers to a sound criticism, in order to see how far they can endure a close examination, and whether they really prove what they profess to do.

Supposing that the thimble-like corpuscles penetrate into the yelk, the most important question is, whether this penetration takes place in accordance with the description of Nelson or that of Meissner. Nelson found numerous seminal corpuscles adhering to the surface of the eggs, which we readily believe, as these corpuscles very easily adhere to foreign objects by means of their flocculent extremity. This adhesion to all possible bodies is even the cause of the error into which Bischoff, Leuckart, and Eckhard have fallen. Nelson, however, goes still further, and says that he has seen how the seminal corpuscles pressed-in the surface of the yelk, and finally penetrated into it from all sides. There is no doubt that Nelson's figure and description are accurate. Nevertheless, it is a question whether this observer had to do with a natural or with an accidental phænomenon. If we closely examine Nelson's figure, we cannot avoid considering the latter as the more probable. It evidently represents crushed eggs,—and that zoospermia should get accidentally into a crushed egg, cannot be considered strange. Thompson has been more careful than his friend: he has certainly observed the adhesion of the seminal corpuscles on the surface of the eggs and fissures in the outer layer of the vitellus, but he does not venture to assert that he has seen seminal corpuscles in the vitellus itself,—nay, he does not even believe that these phænomena must necessarily be brought in connexion with the act of fecundation. It appears to us, however, that Nelson and Thompson made their observations through the walls of the ovi-

duct itself. This mode of observation is certainly not to be neglected, in order to detect the mutual position of the different parts of the contents; but it is not sufficient, as, on account of the opacity [of the walls], it necessitates a tolerably strong pressure, and consequently an injury to the object. When the walls of the oviduct are cut open under pure water, or slightly salt water, which is better, so that the eggs flow out without force, we do not meet with the eggs with torn surfaces, which Nelson figures. We then see, also, that the adhesion of the seminal corpuscles to the eggs is by no means so frequent as is asserted by the two English observers. We may particularly convince ourselves that this adhesion is effected solely by means of the flocculent extremity.

We therefore think that we must agree with Meissner, when he disputes Nelson's description of the penetration of the seminal corpuscle into the yelk. It still remains for us to examine whether Meissner's representation itself may have a greater right to our support.

It has already been shown that Meissner's micropyle does not exist. This, however, by no means proves that the zoospermia do not penetrate into the yelk exactly at the spot where Meissner has supposed his so-called micropyle to be. Meissner asserts that the seminal corpuscles adhere much more frequently on the place of the pretended micropyle than on any other, and that this adhesion is facilitated by the hood of the corpuscle. This observer, as will be remembered, describes the formation of the seminal corpuscles in a way very different from ours: he makes the formation of the seminal corpuscle take place within the development-cell. As it grows, it must acquire a crooked form, until, suddenly extending itself, its anterior extremity passes through the cell-membrane. In this way the latter is not lost, but remains attached to the corpuscle as a hood. This hood we have, however, been unable to see, and we must entirely dispute its existence. Only once, amongst thousands of seminal corpuscles of *Ascaris mystax*, did one occur, which agreed pretty well with Meissner's figures, and was provided with a hood. In this isolated case, however, we can only see an abnormal formation.

Meissner has figured several eggs upon the pretended micropyle of which a seminal corpuscle is seated. Without wishing to doubt the correctness of the figures, we must still say, that nothing of the kind has ever occurred to us. On the contrary, we repeatedly observed a phænomenon in *Ascaris suilla* which may perhaps throw a perfectly different light upon Meissner's drawings. Thus, in unimpregnated females, ova are not unfrequently met with, which, although their vitelline membrane is

already formed, still present the pyramidal form, and have the apex very long. Such an egg completely reminds one of Meissner's drawings of eggs with seminal corpuscles seated upon the micropyle. Sometimes the vitellus draws back a little from the membrane at the apex, and then the resemblance to one of Meissner's seminal corpuscles, with its hood on, becomes still greater. Nevertheless, it is certain that this process is the apex of the egg, and not a seminal corpuscle; for this observation was always made upon females the sexual organs of which otherwise contained nothing that could be regarded as a seminal corpuscle. Closer observation shows also that we have to do here with an extrusion of part of the yelk. The apex gradually becomes constricted, so that at last it is only connected with the ovum by a narrow neck. A false chorion is then deposited around the portion separated by constriction, just as around the unfecundated egg. For this reason we often find, in the females of *Ascaris suilla*, besides the ordinary eggs, an immense number of corpuscles which are formed exactly like the eggs, but excessively minute. These are not abortive ova, but portions of yelk thrown off from eggs of normal size. This is a phænomenon agreeing with the separation of a small fragment of vitelline matter, which has already been observed in many animals. F. Müller's so-called vesicle of direction is nothing but an extruded portion of yelk of this description. We will not assert that such eggs as those just described have furnished the foundation for Meissner's figures, but this is not very improbable.

What is most in Meissner's favour is his statement, that he has seen undoubted seminal corpuscles in the interior of ova. We have no right to doubt the correctness of such a statement, although the unmistakeable recognition of a seminal corpuscle within the yelk may not always be a very easy matter. If Meissner has actually met with seminal corpuscles in certainly uninjured ova, this is an incontestable proof that the zoospermia, by some way or other, penetrate into the egg. Only one of Meissner's figures represents an undoubted seminal corpuscle within the egg. In the text, however, the author states that he has sometimes met with three or four seminal corpuscles in the same egg of *Ascaris mystax*, and that he has since convinced himself (especially in *Ascaris megalocephala*) that several spermatozoa (sometimes even ten) usually penetrate into the same egg. Unfortunately, it is not evident whether this assertion rests upon direct observation, or whether the author has concluded that there is a simultaneous penetration of several seminal corpuscles, from the fact of his finding the supposed products of their metamorphosis in the eggs. If the last alternative be correct, as appears to be probable, the whole theory of fecundation

set up by Meissner stands upon a very weak footing, as will be shown immediately.

Both Nelson and Meissner saw the seminal corpuscles undergo very important alterations after their penetration into the yelk. According to Nelson's statement, they lose their characteristic form, and become converted at last into irregular, transparent, but strongly refractive masses. Meissner groups these changes together as a gradual fatty metamorphosis. According to him, the seminal corpuscle gradually undergoes a conversion into a drop of fat.

At the first glance we cannot avoid seeing a great concordance in the representations of the two writers,—a concordance which must apparently be indicated as in favour of the observation, all the more because in other respects the two observers above mentioned do not usually take the same path. This agreement is, however, only apparent. It will be remembered that Nelson supposed that in every female a certain number of ova escape fecundation. These are his "false eggs." According to Nelson's statement, symptoms of retrogression soon appear in them. The germinal vesicle disappears, and in its place a certain number of transparent globules, which look like oil-drops, make their appearance. The author thinks that these globules are a product, on the one hand, of the germinal vesicle that has disappeared, and, on the other, of an incipient separation between the vitelline oil and granules. He adds, that these drops cannot be confounded with the small masses produced by the conversion of the seminal corpuscles, because the latter are of an irregular form, and never exhibit the uniform outline of an oil-drop.

We now see that the oil-drops in Nelson's "false eggs" have a much greater resemblance to Meissner's zoospermia converted into fat, than the masses which are produced, according to Nelson, by the metamorphosis of the zoospermia. Meissner has also acknowledged this, and for this reason he denies that Nelson's "false eggs" were unfecundated. The oil-drops contained therein are, with him, metamorphosed seminal corpuscles.

Amongst all these mutually contradictory statements we are in a position to confirm only those of Nelson with regard to his "false eggs" with certainty. If Meissner's theory were correct, every egg, or nearly every egg, in the lower part of the tuba and in the commencement of the uterus, should contain one or several oil-drops. This, however, is by no means the case. It is by far the smallest number of eggs that contain such drops. On the other hand, in the *unimpregnated* females of *Ascaris suilla*, we could trace the formation of oil-drops in a far greater proportion. Not unfrequently, individuals are met with, in the uterus of which most of the eggs are furnished with one or

several drops. These drops are perfectly identical with Meissner's. They are not unfrequently met with larger than four or five seminal corpuscles taken together. Here again, therefore, the study of the unimpregnated females proves of great advantage, and it is to be regretted that it was neglected by previous observers. It is not improbable that the appearance of oil-drops in the egg is to be regarded as a sign of its having missed its object, and that it is destined to die and become retrograde. We cannot assert that the few eggs in impregnated females in which oil-drops are formed have escaped fecundation, for these are also surrounded with the normal chorion, which is only formed after fecundation has taken place. But we may easily imagine that a fecundated egg may from some cause become aborted, and die. It is therefore not impossible that the eggs in question are to be regarded as abortive.

We have received from a friend a confirmation of our observations:—Dr. de la Valette obtained an unimpregnated female of *Ascaris mystax,* and found the formation of oil-drops in great quantity in its ova. By this, De la Valette was induced, quite independently of our investigations, to doubt Meissner's whole theory of the conversion of the spermatozoa.

It is not to be denied that the seminal corpuscles may enter upon a fatty metamorphosis. We find here and there in the genitalia of the females free corpuscles of a fatty aspect, which are possibly produced by the metamorphosis of seminal corpuscles. But even then it is a question whether this metamorphosis is a necessary step in the cycle of development of the seminal corpuscle, or whether the fatty metamorphosis is not a consequence of its death. However it may be, we must declare Meissner's observations to be insufficient, as he did not detect the formation of oil-drops in unfecundated eggs; and the question will not appear unsuitable, whether any of the oil-drops observed by Meissner in the eggs of *Ascarides* were ever produced by the metamorphosis of seminal corpuscles.

5. *On the Movements of the Seminal Corpuscles.*

Hitherto Schneider's observations upon the movements of the seminal corpuscles in the Nematoidea* have neither been confirmed nor controverted. It is scarcely possible to doubt the accuracy of the observations, as the report itself indicates great care in the investigation. We may, however, still ask whether the corpuscles in question were true zoospermia, or perhaps foreign beings, parasites; and, secondly, whether the movements observed were normal.

* Monatsber. der Berl. Akad., April 1856.

In recent times we have been constantly becoming more and more familiar with the idea, that the simplest elements of organic nature are not unfrequently endowed with a peculiar contractility, which resembles the mode of movement of the *Amœbæ*. Thus we have very recently been made acquainted by Leuckart* and Kölliker† with such phænomena in the cells of the liver of the Rabbit, in the cells of the mantle of the *Ascidia*, and in the cells of the ligamentous tissue in the *Torpedo*. The phænomena of motion discovered by Schneider in the seminal corpuscles of the Nematoidea would therefore be only a new member in this series of observations.

It was not Schneider, but Bischoff, that first attempted a comparison between *Amœbæ* and the seminal corpuscles of the Nematoidea. But in this comparison Bischoff had in his mind mere phænomena of diffusion, which he had detected in the seminal corpuscles of *Ascaris mystax*, and his observations have nothing to do with those of Schneider.

In accordance with Schneider's recommendations, we have opened the animals under examination, sometimes in white of egg, and sometimes in solutions of common salt or sugar. We never succeeded in any species in detecting phænomena of motion in the seminal corpuscles taken out of the seminal vesicle of the male. This was also the case with Schneider. The result was, however, very different when seminal corpuscles taken out of the tuba or out of the uterus were subjected to observation. Amongst the species examined, one is especially adapted for the investigation of the phænomena of motion in question; this is the *Strongylus auricularis*, which we shall therefore consider more particularly here.

In the first place, we are struck by the number of different corpuscles which occur besides the ova themselves within the female genitalia. Bagge‡ has already stated that the seminal vesicle of the male contains corpuscles of a form very different from those which he was inclined to regard as seminal corpuscles in the female. The former are the conical corpuscles, often resembling the horn of a chamois in form, which have already been mentioned. The second constitute round cells furnished with an elongated nucleus. This observation of Bagge's is perfectly correct, but incomplete. Not only the nucleated cells, but also corpuscles exactly similar to those from the male seminal vesicle, and besides these, others of an irregular form which

* Die Blasenbandwürmer und ihre Entwicklung. Giessen, 1856, p. 121.

† Sur les mouvements particuliers des cellules plasmatiques, &c. Gazette hebd. de Médecine, No. 48, 1856.

‡ De evolutione *Strongyli auricularis* et *Ascaridis acuminatæ*. Erlangæ, 1841.

cannot easily be described, occur in the female genitalia. When the corpuscles of the latter description are observed, we very soon detect in them the extension and retraction of processes—in a word, Schneider's *Amœba*-like movements. They do not all move at the same time, but the majority are usually quiescent; nevertheless we generally meet immediately with individuals engaged in movement. The movements are usually slow and heavy. Not unfrequently, however, we see a corpuscle, the movements of which were previously very slow and cautious, suddenly become more lively and execute several changes of form quickly one after the other, again acquiring its former indolence immediately afterwards.

It is easy to convince oneself that this has nothing to do with phænomena of diffusion, such as Bischoff has described in *Ascaris mystax*. The phænomena of motion go on for hours, and generally become even more lively when the seminal corpuscles have passed an hour in the fluid. That the corpuscles are not parasites, may be easily ascertained in *Strongylus auricularis*, because the seminal corpuscles of this species are of a very characteristic form. Thus we find every intermediate step from the immoveable forms of the zoospermia to the mobile corpuscles, as Schneider has already indicated. In the female sexual organs we meet first of all with conical and horn-like corpuscles, with the base sharply truncated, which agree perfectly with the zoospermia of the male. We also find in the female genitalia other corpuscles of exactly the same form, in which, however, the base is not simply truncated, but somewhat dilated and lobed. Even this form is capable of motion, but it is only the smaller lobed portion that takes part in the movement. The conical or horn-like apex is quite passive; it is dragged along, but executes no movement of its own. The further metamorphosis of the seminal corpuscle consists in the gradual enlargement of the lobed mobile base, whilst the immoveable apex diminishes in the same proportion. The firm apex gradually dissolves into the mobile, irregular portion. Finally, the apex completely disappears, and the corpuscle has a perfectly *Amœba*-like aspect. The cycle of metamorphosis is, however, not yet closed. A nucleus soon makes its appearance in the *Amœba*-like corpuscle, and gradually increases in length. The corpuscle then contracts into a ball, and extends its processes only from a particular side of its surface. The similarity between a seminal corpuscle of this kind and Bagge's nucleated cells is so striking, that no one can miss seeing it. There can be no doubt that the corpuscle with *Amœba*-like movements passes into a cell of this description. The question now is, whether the nucleated cell is a perfectly quiescent state of the seminal corpuscle, or whether it is still capable of motion.

Upon this point we can give no opinion. We have certainly seen nucleated cells furnished with very short processes which were still capable of motion, but we have never succeeded in detecting the extension of processes by nucleated cells which were not previously furnished with a single process.

Sometimes, moreover, females occur in which the last forms of the cycle of development of the zoospermia are wanting. These are undoubtedly such as have only been very recently impregnated.

We have made exactly similar observations in an *Ascaris* from the intestine of *Bufo cinereus,* which is nearly allied to *Ascaris acuminata,* and perhaps identical with *Ascaris commutata,* Diesing.

We have also confirmed Schneider's observations on *Cucullanus elegans,* although, in this case, from the small size of the seminal corpuscles, it is more difficult to convince oneself of the extension and retraction of the processes.

Lastly, we shall add, that, according to oral communications, Wagener and Lieberkühn have completely confirmed Schneider's discovery, in the animal mentioned by the latter in his memoir under the name of *Angiostoma Limacis,* Duj. But they assert that the worm in question is no *Angiostoma,* but an undescribed Nematoid worm.

There can consequently be no doubt about Schneider's discovery of the power of motion of the seminal corpuscles in the Nematoidea. The only question is, whether this faculty belongs to the seminal corpuscles of all the Nematoidea. In reference to this, we have in vain examined those of *Ascaris suilla* and *A. mystax.* In these we have been unable to detect any signs of movement. Nevertheless we can by no means deny that these seminal corpuscles possess some power of movement. Their flocculent extremity too closely resembles the lobed base of the seminal corpuscles of *Strongylus auricularis* for us to suppose that it is not an organ of motion. Perhaps in these zoospermia the movements are so slow that they have escaped us. Perhaps, also, we may not have hit the right degree of concentration of the solution of salt.

6. *Retrospect.*

In conclusion, we will sum up the principal results of this memoir:—

1. Bischoff's epithelial conules are seminal corpuscles, as Nelson, Meissner and Thompson have correctly asserted.

2. Meissner's female germ-cells have no existence. The representation given by this observer of the formation of the egg in the Nematoidea, must be regarded as entirely wrong.

3. The rhachis occurring in the vitellogene of certain Nematoidea is never an apparent one in Meissner's sense, but always an actual one.

4. Meissner's micropyle in the eggs of *Ascaris mystax* does not exist. Bischoff and Thompson have disputed its existence with perfect justice.

5. Whether the fecundation of the eggs is, or is not, effected by the penetration of the seminal corpuscles, remains undecided. At any rate, the observations published by Nelson and Meissner upon this point are insufficient to establish the penetration.

6. Meissner's theory of the conversion of the seminal corpuscles into fat is destitute of any solid foundation, and can by no means be sustained.

7. The formation of fat-drops takes place in great proportion in the unfecundated eggs.

8. Schneider's statement as to phænomena of movement in the seminal corpuscles of certain Nematoidea is founded upon very accurate observations, which are confirmed not only by our own, but also by those of G. Wagener and N. Lieberkühn.

XX.—*On the Investigation of Vegetable Tissue by the aid of Polarized Light.* By H. von Mohl*.

Polarized light offering a most sensitive means of discovering very slight differences, such as cannot be detected in any other way, between bodies which in every other respect behave exactly alike, the idea readily suggested itself of applying it in combination with the microscope to the examination of the structure of organic bodies. In addition to the isolated observations of Biot, Brewster, and others, we possess more comprehensive treatises on the investigation of vegetable tissue by means of the polarizing microscope, by K. von Erlach, Ehrenberg, and Schacht †. Of these, Erlach occupied himself more with the physical explanation of the phænomena which doubly-refracting substances exhibit on the polarizing microscope, than with extended researches upon vegetable structures.

The most general conclusion which Erlach drew from his researches was, that every organic substance of a certain thickness,

* Botanische Zeitung, January 1, 1858.

† Dr. Karl v. Erlach, Müller's Archiv f. Anat. u. Phys. 1847, p. 313. Ehrenberg, Bericht Berlin, Akad. 1849, p. 55. Schacht, Pflanzenzelle, 1852, p. 429; Lehrbuch d. Anat. u. Phys. d. Gewächse, 1855, i. p. 428. Whether the works of Boeck should be enumerated here, I know not, since I have not access to the originals, and the extract given by Hannover (Müller's Archiv, 1844) is too imperfect.

in its natural condition, has the power of diverting transmitted polarized light in determinate directions. As a special investigation, he devoted his attention especially to the examination of the cells of the coats of bulbs, in which he observed that the horizontal section of their wall is invisible on the dark field when the walls are placed parallel with the plane of polarization of the transmitted rays, while they are seen with more or less bright illumination when they are placed obliquely towards this plane, and appear in the brightest light when they are inclined at an angle of 45° to this plane. He subjected the phænomena exhibited by starch-granules to elaborate investigation, and explained the analogy between them and cell-walls. He overlooked the distinction which exists between these two classes of structures in their action upon polarized light. In nuclei, and in the other granular structures occurring in cells, he likewise detected traces of an influence exerted upon polarized light.

Ehrenberg's treatise differs essentially in character from that of Erlach. While the latter worked more as a physicist, and endeavoured to deduce by the aid of calculation, from a small number of accurate observations, the laws according to which vegetable matter acts upon polarized light,—Ehrenberg's essay is infinitely richer in observations in all the kingdoms of nature, but on the other hand, his theoretical reflections are less satisfactory. In opposition to Erlach, Ehrenberg totally denies that all organic tissues possess the power of doubly-refracting light; in particular he disputes the existence of this property, among the class of objects now under consideration, in the nucleus of the vegetable cell, chlorophyll-granules, yeast, inulin, the tissue of fleshy and filamentous Fungi, and in the scales upon the leaves of *Olea, Rhododendron,* and *Myrica.* He gives special illustrations of the scales of certain plants and of starch-granules. From the circumstance that the scales of *Tillandsia usneoides* and other plants, similar in structure to those of the plants above named, act very strongly upon polarized light, while the others do not exert this influence, he drew the conclusion that the cause of the action of those scales did not lie in the organic structure alone, and in the arrangement of the membranous cells, but in some doubly-refracting substance that was spread over the external or internal surface of the membrane of those cells; this substance, though it agreed with starch in the character that it could be removed by acids, was not starch, because it could not be converted into dextrine by heating. In reference to starch, Ehrenberg remarks, that besides the ordinary roundish and longish granules in which a rectangular or oblique cross is visible under the polarizing microscope, there exists a third form (in *Alpinia Galanga* and allied plants), where the granules are extended

lengthwise, and in which black longitudinal striæ are visible in polarized light. He was inclined to attribute the doubly-refracting property of starch-granules and the substance contained in the scales of plants, not to conditions of tension, but to a minute crystalline condition, somewhat comparable to the concentric arrangement of the needles of carbonate of lime in pearls and pisolites.

Schacht's essay is an extremely small affair. It acquaints us with one single correctly observed fact not mentioned by his predecessors, namely the appearance of a black cross in the vicinity of the pits of fir-wood, of the endosperm-cells of *Phytelephas*, &c. All the rest of his statements (omitting the long-known and unmistakeable fact that starch-granules and transverse sections of thick-walled cells of plants exhibit a black cross) are false. The whole work is consequently not merely valueless in itself, but positively injurious, since it is only calculated to lead inexperienced readers into error. According to Schacht, unstratified membranes (cambium-cells, the parenchyma of young organs) do not possess the power of doubly-refracting light. This is totally false: equally devoid of truth is the statement that the polarizing microscope may be employed to detect whether vegetable cell-membrane has formed broad layers of thickening. Not less false is the further assertion, that the chemical character of vegetable matter is not concerned in its effects upon polarized light: the very reverse is the case. In the same way, the assertion is incorrect that vegetable membranes do not act upon polarized light when it passes through in a direction perpendicular to their surface.

If my investigations have led to the discovery of phænomena that escaped my predecessors, the reason lies not in the application of new apparatus, but chiefly in the circumstance that I took great pains to give the polarizing microscope the most advantageous arrangement, and especially to improve the illumination. It would lead me too far to enter into a description of the contrivances that suggested themselves to me; I shall take another opportunity of doing this.

In passing to the account of the phænomena which the vegetable tissues exhibit in the polarizing microscope, I shall confine myself to the detail of the facts, and only intersperse theoretical considerations so far as they may appear necessary for the comprehension of the phænomena, by those who are not acquainted with the properties of polarized light and of doubly-refracting substances, which come into play here.

I commence with the consideration of the *cellulose membranes*. The action which these exert upon polarized light, is perhaps shown most clearly in the examination of a thin transverse sec-

tion of regular circular structures, it being of little consequence here whether we select the section of a colourless or only slightly tinged * cylindrical cell, for instance, of a *Nitella*, or of a cylindrical vessel, for example, of the pitted tubes of a monocotyledonous plant, or the ring of an annular vessel. With the crossed position of the Nicol's prisms, such an organ presents itself in the black field of the microscope in the form of a ring, self-luminous with white light. But its light does not exhibit the same intensity in all parts. In the direction of two lines crossing at right angles in the centre of the ring and standing perpendicular to the transverse diameter of the rhombic surfaces of the Nicol, the ring is destitute of light, so that it is invisible at these places, and appears divided by thin black stripes into four quadrants, each of which exhibits the greatest illumination in the middle (at a distance of 45° from the dark stripe), and becomes gradually duller outwards toward the black stripes.

If the Nicols are placed parallel, the organ is seen on a bright field, as in the ordinary microscope, like a transparent body, but here again not uniformly bright, for now the previously black invisible parts of the ring transmit the brightest light, while the formerly most clearly illuminated parts appear more or less darkened.

To pause a moment at this long-known fundamental phænomenon, and give an explanation of it, may not be superfluous to many readers, and this is the more important, since the explanation of most of the subsequent observations follows at once on the comprehension of the facts above stated.

The lower Nicol's prism, placed between the mirror and the object, divides the light into two halves, which, according to the now generally accepted undulatory theory, are so separated from one another, that the plane in which the waves of one portion vibrate, stands perpendicular to the plane of vibration of the other portion. One of the halves of the light suffers total reflection by the Nicol, and hence does not arrive at the object; the other half, whose rays, as above said, all vibrate in one plane, pass through the Nicol to the object and through this into the microscope. This light however is incapable of passing through the Nicol placed above the eye-piece, when this is made to cross the lower Nicol at right angles; therefore the field of the microscope appears black. But these rays pass unobstructedly through the second Nicol when it is placed parallel to the first, and hence

* Dark colour of the membranes, as in many tropical woods, ferns, &c., offers great obstacles to the detection of phænomena of polarization. When such organs are investigated, it is requisite to destroy the colour by means of oxidizing agents, for instance, with Schulze's mixture of nitric acid and chlorate of potash.

in this case the field appears light, as in the ordinary microscope.

If, when the Nicols are in a crossed position, we place a simply-refracting body, for instance a crystal of common salt, in the focus of the microscope, this exerts no influence on the polarized light coming from the lower Nicol: the light passes through the body freely, without suffering any alteration of the direction of its vibration, and is incapable of arriving at the eye through the upper Nicol; so that the body is not seen. But the conditions are essentially different when a doubly-refracting body, *e. g.* a plate of mica, selenite, &c., is placed in the focus of the microscope. When such a body is revolved in a horizontal direction round the axis of the microscope, it will behave in four positions like a simply-refracting body, and be invisible; this invisibility will supervene anew each time the body is rotated a quarter of a circle from one of these positions, while in the intermediate positions the body will be visible. If now in each of these four positions in which the body is invisible, we draw in imagination, or in reality, upon it, passing through its centre, a line which stands perpendicular to one of the two Nicols, we find upon the body two lines crossing at right angles, which are designated as the neutral axes. In using this name, it must be kept in view, that it implies not only the lines drawn through the centre of the body, but also those which run parallel with them, and that these denote the two directions, crossing at right angles, of which one is parallel to the direction of vibration of the polarized light, the other perpendicular to the same, when the object is invisible. Therefore when it is desired to draw a figure of these axes, they must not be represented in the form of two lines crossing at right angles, but as two systems of parallel lines crossing each other at right angles.

If the doubly-refracting body is placed in any other position, it will be visible through the upper Nicol, and with a light proportionately brighter, as the angle under which its neutral axes are inclined toward the transverse diameter of the Nicol, approaches an angle of 45°. The undulatory theory explains this becoming-visible of the body by the assumption that the polarized light, when its plane of vibration is not parallel with one of the neutral axes of a doubly-refracting body, is divided in its passage through the latter into two portions, whose planes of vibration are perpendicular to each other, whereby the light modified in this way acquires the power of passing, certainly with more or less diminished intensity, through the upper Nicol, and of rendering the body in whose interior this division of the light into two bundles occurs, visible, as an apparently self-luminous object*.

* The reader who desires more detailed information respecting the

If the Nicols be placed parallel, the neutral axes of the object standing perpendicular to surfaces of the Nicols, the light will pass unaltered through the object and the upper Nicol; but when the neutral axes are rotated under 45° in relation to the Nicol, the light will suffer the above-described decomposition, and pass through the upper Nicol with diminished intensity, and the body will consequently appear more or less dark in comparison with the free part of the field.

The foregoing phænomena place us in a position to investigate whether a body possesses a doubly-refracting power, and in what direction its neutral axes lie.

If we direct our attention to the vegetable organs above mentioned, it is clear, from their becoming visible in polarized light, that their substance is doubly-refractive, and, from the position of the four black lines, that one of the neutral axes lies in the direction of the tangent of the circle, the other in the direction of the radius. Since it is known that the membrane of these annular structures is composed of concentric layers, the said phænomena indicate that in a lamellated cell-membrane viewed in its transverse section, one neutral axis is parallel with the lamellæ, the other perpendicular to them.

This is confirmed by the examination of any cellular tissue whatever, in which it is found without exception, that those side-walls of the cells which stand in a position perpendicular to one of the two Nicols, are invisible, and that those membranes appear in brightest illumination which are inclined at an angle of 45° towards the Nicol.

However, the phænomena differ to a certain extent in thick-walled and thin-walled cells. On the surface of a transverse section of a thick-walled cellular tissue, for instance of the albumen of *Phytelephas,* in which each individual cell, it is true, represents in its extreme outline a quadrangle with straight sides, but the secondary layers, in proportion as they lie more internally, approach more and more the form of a circle by the rounding-off of their angles,—it is impossible, from the curved form of the majority of the layers, that any side-wall of a cell can be placed perpendicularly to one of the Nicols in its whole extent. Hence, in such a cell almost the whole of the surface of the section will be visible in every position in polarized light, and all that is seen is, as in the circular structure alread mentioned, four black stripes, standing at right angles to each other, but less regular in form and position than in the trans-

optical matters here concerned, and in particular as to the intensity of the light dependent on the angle of inclination of the neutral axes to the diameter of the Nicol, will find a minute account in the treatise of Erlach above mentioned.

verse section of a cylindrical cell, because the inner and outer layers of the cell-wall have not the same accurate concentric arrangement as in the latter.

The transverse section of a thin-walled tissue formed of polyhedral cells, in which the cut surfaces appear in the form of straight lines, presents an appearance deviating in many respects. In such a section a more or less considerable number of the cell-walls are placed perpendicularly to one of the two Nicols; these consequently remain totally invisible, while the remainder of the walls, standing obliquely as regards the Nicols, appear uniformly bright in their whole length. From the apparent deficiency of part of the cell-wall, the figure acquires an unconnected appearance, and looks as if it were a torn and imperfect preparation. But if, while looking into the microscope, the object is rotated in a horizontal direction, the previously invisible cell-walls emerge from the darkness, while others previously illuminated become invisible.

To see these phænomena in their full beauty, choice should be made of a thin transverse section of a tissue composed of more or less elongated thin-walled cells, *e. g.* of the stem of herbaceous Monocotyledons, or of the wood of *Æschynomene paludosa*: the transverse section of short polyhedral cells, *e. g.* of Elder pith, is less advantageous, because in this, horizontal walls of cells and obliquely-directed side-walls come into view in many places in company with the horizontal external surfaces of the side-walls, which produces a complication of the phænomena. In making the preparation, two points must be borne in mind. In the first place, the section must be made thinner in proportion as the substance of the object acts more strongly upon polarized light. The best image is obtained when the preparation appears with bright white light: if the section be too thick, it presents more or less of prismatic colouring in its different parts, which is unfavourable in many investigations. The second precaution, which must never be lost sight of, relates to the fluid in which the object is kept. Most vegetable substances refract light far more strongly than water: in the same degree as this circumstance is favourable in ordinary microscopic investigations, is it unfavourable in researches with the polarizing microscope. In this the best image is obtained when the refractive power of the preservative fluid stands as near as possible to that of the object. Hence, when the nature of the object allows, as is the case with cellulose membranes, starch-granules, &c., it should not be examined in water, but in essential oil, for instance oil of turpentine, or mounted in Canada balsam or a similar resinous substance. The more transparent the preparation becomes, the more beautiful is the image that it gives.

We will examine, in the first place, whether the power of cell-membrane to doubly-refract light is connected with its lamellation. Schacht asserts this most decidedly, for he states that only thickened cell-membranes are doubly-refractive; that very delicate-walled vegetable cells (such as the cambium-cells of the vascular bundle of *Abies pectinata*, the parenchyma of young structures, the tissue of Fungi and Lichens) are completely invisible upon the dark field, and therefore simply refract light; and that consequently it may be determined by the polarizing microscope whether or not a cell has already deposited layers of thickening. These statements are false. Even from theoretical reasons, it was not to be assumed that a lamellated membrane which is traversed by light parallel with the planes of lamellation, acts as a doubly-refracting body on account of its lamellation,—the property of double refraction must depend upon the arrangement of the molecules in each of the separate layers. It is without doubt within the limits of possibility that primary membrane should be distinguished in this respect from the secondary layers; but observation proves that this is not the case. It is a known fact that a doubly-refracting body acts the more weakly upon polarized light the thinner it is, wherefore in very thin lamellæ of crystals, as well as in organic membranes, the effect may be reduced below the last degree of which the detection is possible. Hence in examining young vegetable structures we cannot expect to see their thin membranes upon the black field with the same brightness as in thick-walled cells. Nevertheless, in almost all the cases examined by me, the membranes which from their youth and organization we are accustomed to regard as primary, behaved to polarized light most clearly in the same way as those of thickened cells, that is, as doubly-refractive. In particular, the membranes of the cambium-cells of all the Dicotyledons I examined, *e. g.* of *Pinus sylvestris*, *P. nigricans*, *Impatiens Balsamina*, *Sambucus Ebulus*, and especially clearly that of *Viscum album*, appear in bright light when placed at an angle of 45° to the Nicol; still more clearly was this the case in the membranes of the clathrate cells (*gitter-zellen*, Mohl) erroneously referred to the cambium, both in Monocotyledons, for instance in *Musa*, *Canna*, *Renealmia nutans*, and Dicotyledons, *e. g.* in *Bignonia*; which membranes, it is true, are already, as their pits show, composed of a number of lamellæ. The same appearances were equally clear in the cell-membranes of the embryo of *Pinus Pinea*, in the cambial tissue of the apex of the stem of *Cocos coronata*, and in the primary coat of the spiral cells of *Echinocactus multiplex*. In certain very thin-walled fibrous cells, as in those of the leaf of *Sphagnum cymbifolium*, and those of the wing of the seed of *Swietenia Mahogani*, the action exerted upon polarized light by

that portion of the membrane not covered by fibre was certainly so weak, that it could not be detected without the interposition of a doubly-refracting medium between the lower Nicol and the object; but by the aid of this, that is to say, by interposing a thin plate of mica, it appeared most clearly. The assertion that the primary cell-membrane forms an essential contrast to the layers of thickening in respect to its behaviour towards polarized light, is therefore decidedly incorrect. No better grounded did I find Ehrenberg's statement, repeated by Schacht, that the scales of the leaves of *Olea, Rhododendron* and *Myrica* do not act on polarized light; for the scales of *Olea europæa, Rhododendron hirsutum,* and *Myrica quercifolia,* especially the first two, most decidedly possess this power, although in a weak degree.

It is not meant here, however, that the substance of all cell-membranes acts with uniform force upon polarized light, and that the brightness with which a membrane appears upon the black field depends only on its thickness. On the contrary, most important distinctions in this respect occur, according to the modifications which the cellulose exhibits in different cells, and indeed according to the diversity of the foreign matters imbedded in the cell-membranes. In general, a cell-membrane acts the more strongly upon polarized light, and appears in the greater brightness, the more solid its substance is, and *vice versâ*; hence, in general, wood-cells and liber-cells appear most illuminated: the membranes of ordinary parenchyma likewise possess this property in a high degree, for which reason a delicate cross section of a stem, especially of a monocotyledonous plant, presents a most elegant picture, through the contrast which is made by the silvery lustre of its cell-membranes with the black ground of the field. But when the cell-membranes swell up more or less with water into a gelatinous condition, as in the Fucoideæ, or in the collenchyma-cells lying beneath the epidermis, *e.g.* of *Sambucus Ebulus, Beta,* or *Rheum,* their capability of becoming visible in polarized light diminishes to a more or less considerable extent. This is the case in a particularly high degree when the disintegration of the outer layers of the cells goes so far, that they are blended into what appears like a homogeneous intercellular substance. Yet even in these cases the power of acting upon polarized light is perhaps never totally lost; at least I found the intercellular substance of *Fucus vesiculosus* decidedly doubly-refractive; and the slimy substance of *Nostoc commune,* of *Collema nigrescens* and *C. flaccidum* behaved in a similar manner. The apparently perfectly structureless intercellular substance in the endosperm of many Leguminosæ also, for instance of *Sophora japonica* and *Schizolobium excelsum,* acts decidedly upon polarized light; here, however, in the irregular

masses which these substances form in the swollen-up condition, the position of the neutral axes can no longer be discovered, but certain not clearly defined parts of the substance appear light, others dark, and on horizontal rotation of the object become alternately light and dark. In the swollen cells of gum-tragacanth likewise, traces of double refraction may still be detected.

Besides these more or less disorganized membranes, cell-walls occur in many plants which exert only a very weak effect upon polarized light. To these belong, for example, the parenchymatous cells of the cotyledons of *Lupinus hirsutus,* in spite of the considerable thickness they possess. The same is the case in most of the cells of the Lichens and Fungi. That these are simply-refracting bodies, as Ehrenberg asserted of the membranes of Fungi, and Schacht of these and of those of the Lichens, is incorrect. In the Lichens the looser filamentous cells of the so-called medullary substance exhibit an action upon light at least evident in all cases, for example in *Roccella fusiformis* and *Parmelia ciliaris,* while the firmer central substance of *Usnea,* and, above all, the cortical layer of all the Lichens I have examined, act with tolerable strength. In the Fungi the facts differ a good deal according to the species. While in many species of very delicate structure, for instance in the mycelium of *Erisyphe,* the effect, though always evident, is but weakly exhibited; in other species, the first glance removes all doubt that the thin cell-membranes behave towards polarized light in exactly the same way as the cellulose membranes of the Phanerogamia. Thus the threads of *Mucor Mucedo* and *Ascophora Mucedo,* and the filamentous Cells of *Merulius lacrymans,* presented themselves, notwithstanding their delicacy, in very bright light: still more evidently was this the case in Fungi of firmer consistence; for instance, in the cells of the outer peridium of *Geaster rufescens,* and more especially in the cells of the pileus of the harder *Polyporei, e.g.* of *Polyporus hirsutus,* in which, notwithstanding the small diameter of the cross section of the filaments, I repeatedly saw most distinctly the black cross corresponding to the neutral axes. These appeared on the surface of transverse sections of the rather thick coat of the unripe spores of *Tuber cibarium,* with a clearness equal to that in the cross section of a vessel of the Phanerogamia. The spiral cells of the capillitium of the *Trichiæ* also are among the membranes acting powerfully upon polarized light.

Not only do the cells of different plants, or the cells of different organs of the same plant, thus exhibit great distinctions in their effect upon polarized light, but not unfrequently a similar distinction occurs between the different layers of one and the same cell, whence the polarizing microscope is in many

cases a means of rendering visible, lamellæ which are difficult of detection with the ordinary microscope. In this respect it is a pretty common phænomenon for the primary membrane, and likewise the tertiary layer immediately lining the cavity of the cell, to act more powerfully upon polarized light than the secondary layers; they therefore appear in far brighter white light than the latter. In particular cases, for instance in the parenchyma-cells of the cotyledons of *Lupinus hirsutus*, the secondary layers act so weakly, that when an objective which does not admit a great deal of light is used, they are almost invisible without the interposition of a doubly-refractive medium in the illuminating apparatus, while the primary and tertiary membranes appear in the form of delicate luminous lines. In like manner, in the collenchyma-cells of the stem of *Sambucus Ebulus* and *Cucurbita Pepo*, the primary membrane is most remarkably distinguished from the disintegrated secondary layers, which I formerly erroneously regarded as intercellular substance, by a far greater brilliancy, so that one may make most absolutely certain that the so-called intercellular substance is here not deposited between the cells, but is traversed by the primary cell-membranes. A similar, although not so clearly marked contrast between the primary and tertiary membranes, occurs also in many thick-walled wood- and liber-cells; for instance, in a high degree in the thick-walled cells of the vascular bundles of the outer layers of the stem of *Aletris fragrans* and in the liber-cells of *Rosa canina*; and in a less degree in the wood-cells of many Coniferæ, for instance of *Abies pectinata* and *Torreya taxifolia*. In other, but rarer cases, the primary membrane acts less strongly upon polarized light than the secondary layers, so that the latter appear separated from each other by a darkish line, for instance in the endosperm of *Phytelephas*.

Cellulose membranes undergo no essential alteration in their behaviour to polarized light when they are freed from the compounds deposited in their substance, by boiling in Schulze's mixture of nitric acid and chlorate of potash. We must conclude from this, that the action exerted by the cell-membranes is attributable to the cellulose itself of which they are formed, and depends upon the arrangement of their molecules connected with their organic structure. Ehrenberg, from the behaviour of the scales of certain plants, promulgated the opposite opinion. He thought he had found that many scales, such as those of the leaves of the Olive, do not act upon polarized light, while others, such as those of *Elæagnus* and *Tillandsia usneoides*, exert this influence in a high degree. Believing, further, that he had discovered that the said property might be abstracted from the latter scales by the aid of acids, he came to the conclusion that

the efficiency of the scales was not attributable to them as a consequence of their organization and the arrangement of their cells, but that the cells of the effective scales were lined or coated with a doubly-refractive substance, removable by acids. Not only, as above noticed, is this statement of the want of action in the scales of the Olive incorrect, but the second statement, that acids remove the efficiency of the scales of *Elæagnus*, is only correct in the most limited degree, and is explicable in a different way from that in which Ehrenberg viewed it. Even twelve hours' maceration of these scales in fuming nitric acid or hydrochloric acid exerts no influence upon them, while sulphuric acid in a short time weakens the property in question extremely, without however fully destroying it. As to the cause of this, microscopic examination of the scales treated in this way leaves no doubt, since it demonstrates that the sulphuric acid dissolves the secondary lamellæ of the cells, and reduces the cell-membrane to an excessively thin pellicle. Consequently these scales cannot be adduced in evidence to prove that cellulose does not possess, independently and in itself, the property of double refraction. This renders superfluous any discussion of the hypothesis appended by Ehrenberg, that this unknown substance lining the cells may be crystallized.

It might be conjectured that the remarkably active effect which the epidermal cells of *Equisetum hyemale* exert upon polarized light, is to be ascribed to the deposition of abundance of silica in the substance of their cell-membranes. But this conjecture finds no confirmation in the circumstance that the effect of these membranes upon polarized light is exceedingly weakened when their organic substance is destroyed by heating to redness. However, this operation does not entirely destroy this action, neither does it in the Diatomeæ, in which, contrary to the statement of Ehrenberg, lately confirmed by J. W. Bailey (Quarterly Journal of Microscopic Science, 1856, p. 303), many forms, namely various species of *Navicula, Synedra,* but especially of *Pleurosigma,* and *Melosira arenaria,* were found by me to be decidedly doubly-refractive.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

BOTANICAL SOCIETY OF EDINBURGH.

January 14, 1858.—Dr. Seller, President, in the Chair.

The following papers were read :—

1. "On the Occurrence of a new *Muscari* on Mount Ida," by Dr. John Kirk.

In April 1856, the author and two other medical officers of the

hospital of Renkioi ascended Mount Ida. He says—"Early in the morning we began to ascend on foot. Proceeding in an oblique direction for some time, we came to one of the sources of the Scamander, where it gushes by many powerful springs from the schist rocks. In this neighbourhood we found Saxifrages, Geraniums, *Dentaria bulbifera*, *Ruscus hypoglossum*, and *Pæonia decora* among the fine timber of *Pinus Pinaster* which covered this region. There, too, the *Muscari* was picked in considerable abundance; it seems to be a new species, and we have named it, from its remarkably broad leaves, *M. latifolium*. It now appeared that our guides had deceived us, and taken us off the proper road, and from this point it seemed almost impossible to ascend. But, being determined to reach the top, we set off, leaving them to follow if they chose. Near the summit the forest opened out, and left nothing but bare rock; we picked the *Crocus garganicus*, *Corydalis tuberosa* and *digitata*, *Viola gracilis*, *Scilla bifolia*, *Ornithogalum nanum* and *fimbriatum*. The scanty soil had been turned up by the wild pigs in search of bulbous roots. The ascent had occupied from 7 in the morning till 3 P.M. On our return we followed a much easier path, and here we found the *Saxifraga sancta* growing in wet boggy spots. This species had been previously discovered by Griesbach on Mount Athos. The sun had set by the time we reached the village of Avjylar, and, having enjoyed a night's rest, we set off on our return to the hospital, where we arrived on the fifth day from our departure." Dr. Kirk briefly indicated, in the following terms, the characters of the new *Muscari*, which will be more fully described before he leaves for the Zambesi:—*Muscari latifolium*. Scape erect, about 12 inches in height, rising from a globose bulb, and bearing near its base a large sheathing, broadly lanceolate, rather obtuse, solitary leaf; flowers numerous, forming a raceme about 2 inches in length, the lower ones shortly pedicellate, the upper ones barren, sessile; perianth tubular (blue), in the fertile flowers inflated below.

2. "Note on *Cryphæa* (*Daltonia*) *Lamyana*, Montagne," by Dr. George Lawson.

Dr. Lawson stated, that in 1836 M. Montagne had described and figured, in apparently a very careful manner, a new moss found near Vienna, under the name of *Daltonia Lamyana**. Subsequent writers had referred it to *D. heteromalla*. Specimens shown to the meeting, which had been collected in the river Taw by the Rev. C. A. Johns, were considered by Mr. Wilson and others to be identical with M. Montagne's moss; but they differed so widely from his elaborate description, that Dr. Lawson thought the whole subject was still deserving of inquiry. The points which remain to be determined are these:—1. Is *D. Lamyana*, Montagne, a good species? 2. Is the English plant identical with it?

3. "On the correspondence between the Serial Internodes of Plants

* Ann. des Sc. Nat., 2 série, Botanique, tom. vi. pp. 327–329. tab. 18. fig. 2.

and Serial Crystalline Forms," by Mr. Wm. Mitchell. Communicated by Professor Balfour.

4. "On *Macadamia,* a genus of Proteaceæ," by Dr. George Lawson.

The genus referred to is *Macadamia* (Müller), described in the 'Trans. of the Philos. Inst. of Victoria,' vol. ii. p. 72. It is a native of subtropical Australia.

ZOOLOGICAL SOCIETY.

July 14, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

On Stoastomidæ as a Family, and on Seven proposed New Genera, Sixty-one New Species, and Two New Varieties from Jamaica. By the Hon. Edward Chitty.

[Concluded from page 150.]

Genus VII. Lindsleya.

Shell globose-conic.

Lindsleya Lindsleyana, Chitty. See *Stoastoma Lindsleyanum,* Adams. Mon. Stoast. Ad. 1849, p. 12; Cat. Phan. p. 229.

Hab. Manchester back-woods.

Lindsleya Pickeringiana, Chitty.

Hab. ——?, ? Manchester, ? Yallahs Hill.

Form, globose-conic. *Colour,* very pale horn. *Sculpture,* 17 strong blunted rounded spiral carinæ, within each interspace one or rarely two very fine carinæ: on the upper whorls 5, with a fine one in each interspace. *Spire,* well elevated, with straight outlines. *Apex,* rather sharp. *Whorls,* 5, well rounded, with a deep suture. *Aperture,* almost exactly semicircular, rather depressed below. *Labrum,* rather curvilinear in its plane, very slightly produced above, pectinated strongly by the strong carinæ. *Labium,* moderately detached from body-whorl, very slightly curved to the right below; on a plane with the labrum above, slightly lower below. *Umbilicus,* moderately deep and broad. *Labral lamella,* produced broadly, but sinking immediately into the umbilicus. *Operculum,* moderately concave, with a rather broad margin, with, on the labral side, 5 or 6 raised lamellæ converging towards the umbilicus, the labral side close to its lower extremity bending to the right like the labium, and at its very extremity furnished with a fine linguiform projection which spreads slightly over the labium.

Height 0·086, greatest breadth 0·14, least breadth 0·086.

Named in compliment to John Pickering, Esq., a collector of British shells.

This shell in many respects resembles *L. Lindsleyana,* but is much larger, and its proportions under measurement are very dissimilar; its aperture is wider, and apex much sharper.

Lindsleya Redfieldiana, Chitty. See ***Stoastoma Redfieldianum***, Adams. Mon. Stoast. Ad. 1849, p. 13; Cat. Phan. p. 229.

Hab. Peace River, Manchester.

Lindsleya Jayana, Chitty. See ***Stoastoma Jayanum***, Adams. Mon. Stoast. Ad. 1849, p. 14; Cat. Phan. p. 230.

Hab. —— ? Manchester.

Lindsleya Leana, Chitty. See ***Stoastoma Leanum***, Adams. Mon. Stoast. Ad. p. 15; Cat. Phan. p. 229.

Hab. Peace River, Manchester.

Lindsleya Denisoniana, Chitty.

Hab. Moreland, Manchester.

Form, globose-conic. *Colour*, pale horn. *Sculpture*, lines of growth visible: 4 strong spiral carinæ and 1 fine; 6th strong, 7th fine; 8th strong, and 9th and 10th fine; 11th strong, 12th to 15th fine; 16th strong, 17th to 19th fine; 20th strong, 21st to 23rd fine; 24th strong, 25th and 26th fine; 27th strong, and 28th to 36th fine; on upper whorls, 5 strong, with fine ones on the intermediate spaces. *Spire*, much and concavely elevated. *Whorls*, $3\frac{3}{4}$, convex, with a well-impressed suture. *Aperture*, more than a semicircle, more angular above than *L. Leana*, very slightly constricted and dilated again slightly, more so below; less campanulate than *L. Leana*; aperture larger and wider above than *L. Leana*. *Labrum*, not produced above, continuous all round with labium, sharply and slightly reflected at rather more than a right angle, with a ridge on the inner side, very slightly pectinated by about ten points of the strong spiral carinæ, not thickened as in *L. Leana*; rather double below. *Labium*, on a plane with labrum, more closely appressed to body-whorl above. *Umbilicus*, narrow, much deeper and wider than in *L. Leana*. *Labral lamella*, very slightly developed. *Operculum*, —— ?

Height 0·06, greatest breadth 0·074, least breadth 0·056.

Named in compliment to John Denison, Esq., well known for his extensive collection of shells.

Lindsleya Polyblankiana, Chitty.

Hab. —— ? Westmoreland.

Form, globose-conic. *Colour*, light red-brown. *Sculpture*, an uncountable number, say 50, extremely fine, raised, wavy, well-defined spiral carinæ; about 20 on the upper whorls. *Spire*, well elevated, with convex outlines. *Apex*, acute. *Whorls*, $4\frac{1}{4}$, quite round, with a very deep suture. *Aperture*, subelliptical, rather flattened above and broad-spreading, narrowed below and rather straightened on the labial side, not in the least degree angular above or below; labrum and labium continuous, much reflected. *Labrum*, excessively double, especially above, where the outer stands clear out from the

inner edge. *Labium,* much reflected and closely attached to body-whorl, very little straightened. *Umbilicus,* deep and narrow. *Labral lamella,* very fine and narrow, lost immediately in the umbilicus. *Operculum,* —— ?

Height 0·069, greatest breadth 0·071, least breadth 0·056.

Named in compliment to George Polyblank, Esq., a liberal amateur collector.

Lindsleya Albersiana, Chitty.

Hab. John Crow Hill, Portland.

Form, globose-conic. *Colour,* pale yellow. *Sculpture,* 25 fine spiral carinæ; on the upper whorls 9 or 10. *Spire,* well elevated, with rather convex outlines. *Whorls,* 5, well rounded, with a deep suture. *Aperture,* subelliptical, labrum and labium being continuous; white, smooth; slightly expanded and deflected below, very slightly detached from body-whorl, and almost vertical. *Labrum,* double; smooth, white, not affected by the spiral carinæ; continuous with the labium. *Labium,* moderately detached from body-whorl. *Umbilicus,* moderately deep, not affected by the *labral lamella,* which is very little produced. *Operculum,* moderately concave, smooth and shining.

Height 0·049, greatest breadth 0·063, least breadth 0·044.

Named in compliment to Dr. J. C. Albers, of Berlin.

This shell is like *L. Arthuriana,* but differs materially in sculpture, number of whorls, and measurement.

Lindsleya Fischeriana, Chitty.

Hab. —— ? St. Ann's.

Form, globose-conic. *Colour,* pale yellow. *Sculpture,* 6 strong spiral carinæ, with 1 fine in the interspaces; then 3 fine and 1 strong; then 1 fine and 5 strong, with 1 fine in the interspaces; then 3 fine and 1 strong and 1 fine and 1 strong; on the upper whorls 5 strong and 1 fine in each interspace. *Spire,* well elevated with straight outlines. *Whorls,* 4⅔, well rounded, with a deep suture. *Aperture,* very slightly expanded and depressed, scarcely separated from the body-whorl, semicircular. *Labrum,* white, shining, very slightly produced above, very slightly double, largely pectinated by 11 points of the strong carinæ. *Labium,* slightly detached from the body-whorl, upper three-fourths straight, rather abruptly curving to the right below; on a plane with labrum. *Umbilicus,* deep and narrow. *Labral lamella,* strong, wide and sharp, projecting in an angular point a little below its junction with labrum. *Operculum,* —— ?

Height 0·072, greatest breadth 0·086, least breadth 0·072.

Named in compliment to M. Paul Fischer, the well-known French conchologist.

Lindsleya Moricandiana, Chitty. See *Stoastoma Moricandianum,* Adams, Cont. Conch. p. 150; Cat. Phan. p. 230.

Hab. Yallahs Hill ?

Lindsleya Reeveana, Chitty.

Hab. The borders of Manchester, Trelawny and St. Ann's.

Colour, pale horn. *Sculpture,* 7 strong spiral carinæ, those about the periphery being more distantly apart, with in each interspace 3 finer carinæ; on the upper whorls 4 strong carinæ: almost obsolete behind the labrum. Striæ of growth slightly visible. *Spire,* well elevated, with slightly convex outlines. *Whorls,* 4, well rounded, with a deep suture; last whorl well rounded and very globose. *Aperture,* peculiar and very large and spreading, considerably constricted far behind the labrum, very much expanding again like the half of the bowl of a spoon; subangular above and below on the left, depressed above, well dilated on the right below, widest horizontally, flattened below. *Labrum,* at about ⅓rd of the length of the constriction, attached to the body-whorl, in, as it were, a curvilinear opening of about 35°; the spiral carinæ at the back almost obsolete and striæ of growth stronger; double, the outer edge pectinated by 7 points of the stronger carinæ and scolloped; inner edge much thickened, pectinated by about 4 points, much produced and deflected above, modifying the aperture. *Labium,* appressed in its upper end to the penultimate whorl, straight above, slightly curved to the right below, very much below the plane of the labrum. *Umbilicus,* rather deep and very narrow. *Labral lamella,* very finely produced. *Operculum,* well thickened on the labial side, very slightly concave and smooth.

Height 0·061, greatest breadth 0·073, least breadth 0·061.

Named in compliment to Lovell Reeve, Esq., the able conchologist.

Lindsleya Shuttleworthiana, Chitty.

Hab. Burnt Hill Glade, Westmoreland (unique).

Form, globose-conic. *Colour,* —— ? *Sculpture,* striæ of growth very visible, oblique; about 16 strong sharp spiral carinæ, stronger below, with one faint finer in each interspace; on upper whorls 5 strong, with finer intervening. *Spire,* slightly and rather concavely elevated. *Whorls,* 5, moderately convex, with a deep suture; last whorl large and spreading behind the labrum, but, on the left, assimilating the form of the subgenus *Metcalfeia,* and rather falling off below. *Aperture,* semicircular, except as modified by the labium; very slightly spreading. *Labrum,* thin, slightly reflected, pectinated by about 10 points, 4 fine and close on the upper part, 6 strong and wide apart round the periphery, strongest at the periphery; above, moderately produced from the body-whorl in a graceful curve. *Labium,* well detached from the body-whorl, curved throughout, below the plane of the labrum at lower end, thickened and reflected towards the umbilicus. *Umbilicus,* deep and narrow. *Labral lamella,* very slightly produced and immediately merged in the umbilicus. *Operculum,* —— ?

Height 0·072, greatest breadth 0·12, least breadth 0·084.

Named in compliment to Robert Shuttleworth, Esq., of Berne, the well-known botanical and conchological collector and author.

LINDSLEYA BOISSIERIANA, Chitty.

Hab. New Forest, Manchester.

Form, globose-conic. *Colour,* pale horn. *Sculpture,* striæ of growth visible: 12 prominent, not very strong, spiral carinæ, with between the 1st and 2nd, 2 finer carinæ; between 2nd and 3rd and 3rd and 4th, 1 fine; between 4th and 12th, 2 fine; beyond the 12th, 5 or 6 very fine, round the umbilicus: on the upper whorls 5 strong, with intermediate fine. *Spire,* well elevated, with slightly convex outlines. *Whorls,* 5, well rounded, with a deep suture. *Aperture,* more than a semicircle, moderately expanded and slightly deflected below. *Labrum,* but slightly separated or produced from the body-whorl, well pectinated by the strong carinæ. *Labium,* slightly detached from body-whorl, on a plane with labrum above; slightly lower below, moderately curved to the right. *Umbilicus,* deep and narrow. *Labral lamella,* rather produced at junction with labrum, narrow below. *Operculum,* slightly concave, five horizontal lamellæ across it, strongest in the middle, fine granulations, a linguiform sharp projection overlapping the labium.

Height 0·064, greatest breadth 0·083, least breadth 0·067.

Named in compliment to M. Edward Boissier, of Geneva, the eminent naturalist.

LINDSLEYA GASKOINIANA, Chitty.

Hab. Near Ashley Hall, Trelawny.

Form, globose-conic. *Colour,* white. *Sculpture,* 14 strong spiral carinæ, with 2 fine in each interspace; on the upper whorls 5, with fine ones intervening. *Spire,* well elevated, with straight outlines. *Whorls,* 4½, with a moderate suture. *Aperture,* more than a semicircle, subelliptical. *Labrum,* detached from the body-whorl, produced moderately above, very strongly pectinated by about 13 points, slightly expanded, reflected, and depressed below. *Labium,* slightly detached from the body-whorl, curved to the left above, and more so to the right below. *Umbilicus,* shallow and narrow, partially hidden by the gracefully curved but slightly projecting *labral lamella.* *Operculum,* very slightly concave, with a few coarse granulations, overlapping the labium on the labial side.

Height 0·064, greatest breadth 0·084, least breadth 0·064.

Named in compliment to J. S. Gaskoin, Esq., a writer on conchology.

LINDSLEYA NEWCOMBIANA, Chitty.

Hab. Clarendon Mountains (damaged, unique).

Form, globose-conic. *Colour,* ——? *Sculpture,* 18 strong rounded spiral carinæ, with 2 finer intervening at the periphery; on the upper whorls 5. Striæ of growth visible. *Spire,* well elevated, with rather concave outlines. *Whorls,* 5, moderately rounded, with a well-impressed suture. *Aperture,* semicircular, scarcely detached from body-whorl, not expanded or depressed, except slightly below. *Labrum,* very little produced above, pectinated by all the strong lines. *Labium,* well detached from body-whorl, slightly curved

below, on a plane with labrum above, lower below. *Umbilicus*, deep and narrow. *Labral lamella*, slightly and evenly produced. *Operculum*, —— ?

Height 0·08, greatest breadth 0·1, least breadth 0·081.

Named in compliment to Dr. Newcomb, of Albany, N. Y.

LINDSLEYA RIISEANA, Chitty.

Hab. Near Mr. Channer's, Santa Cruz Park, St. Elizabeth (unique).

Form, globose-conic. *Colour*, pale yellow. *Sculpture*, 13 sharp spiral carinæ with 1 finer in each interspace; on the upper whorls 3 strong with fine intervening. *Spire*, well elevated, with straight or very slightly concave outlines. *Whorls*, 4¼, very much rounded, with a deep suture; last whorl large. *Aperture*, sub-semielliptical, slightly expanded, rather flattened above and expanded below. *Labrum*, double, white, thickened, slightly scolloped and pectinated by 8 points, continuous with the labium, very slightly produced above. *Labium*, well detached from body-whorl, continuous with labrum, much curved, more so below, very slightly lower than plane of the labrum below. *Umbilicus*, moderately deep and broad. *Labral lamella*, very slightly produced. *Operculum*, —— ?

Height 0·049, greatest breadth 0·067, least breadth 0·05.

Named in compliment to A. H. Riise, Esq., of the Island of St. Thomas, a scientific conchologist.

LINDSLEYA POEYANA, Chitty.

Hab. John Crow Hill, Portland.

Form, globose-conic. *Colour*, pale horn, almost white at the aperture. *Sculpture*, about 18 strong spiral carinæ, with here and there 1 fine carina intervening, rather inequidistant; on the upper whorls 4. *Spire*, well elevated, with straight outlines. *Whorls*, 4¾, scarcely convex, with a very light suture. *Aperture*, larger than semicircular, rather flattened above, moderately expanded, much on the right below. *Labrum*, slightly double and very little pectinated by the carinæ, produced above and much reflected, scarcely detached from body-whorl. *Labium*, little detached from body-whorl, straight, except the curve to the right below; very little below the plane of labrum in the lower part. *Umbilicus*, moderately deep. *Labral lamella*, very little produced. *Operculum*, concave, minutely granulated.

Height 0·077, greatest breadth 0·11, least breadth 0·078.

Named in compliment to M. Felipe Poey, now of the Havanna.

LINDSLEYA HENRYANA, Chitty.

Hab. Pool's Rock and Halley's Mountain, Hanover.

Form, globose-conic. *Colour*, pale horn. *Sculpture*, 18 blunt coarse spiral carinæ, with 1 very fine (about the periphery) intervening; on the upper whorls 7. *Spire*, well elevated, with straight outlines. *Whorls*, 4¼, well rounded, with deep suture. *Aperture*,

very slightly expanded, more than a semicircle, spreading above and below, very slightly detached from the body-whorl. *Labrum*, thin and smooth, pectinated by about 10 points outwards, scarcely produced above. *Labium*, moderately detached from body-whorl, thin, curved to the right below, on a plane with the labrum above, rather lower below. *Umbilicus*, rather broad, and suddenly very deep. *Labral lamella*, considerably produced, more expanded above; within the umbilicus, and higher up the outside of the labium is another lamella, almost as strong as the labral lamella. *Operculum*, slightly concave, with about 12 very coarse granulations on the labral lower side.

Height 0·053, greatest breadth 0·067, least breadth 0·054.

Named in compliment to Henry Adams, Esq., of London, the conjoint author with his brother Arthur Adams.

Lindsleya Alderiana, Chitty.

Hab. John Crow Hill, Portland.

Form, globose-conic. *Colour*, pale yellowish horn. *Sculpture*, striæ of growth visible; 17 strong spiral carinæ, with 1 fine in each interspace, 3 fine intervening at the periphery, where the strong carinæ are wide apart; on the upper whorls 3, with finer intervening. *Spire*, well elevated, with slightly concave outlines. *Whorls*, nearly 5, moderately convex, with a moderate suture. *Aperture*, semicircular, slightly expanded below. *Labrum*, slightly produced above, rather reflected, scarcely detached from the penultimate whorl, rather strongly pectinated by about 11 of the spiral carinæ. *Labium*, very slightly curved to the right, otherwise almost straight, moderately detached from the body-whorl, rather below the plane of the labrum. *Umbilicus*, very deep. *Labral lamella*, slightly produced. *Operculum*, slightly concave, crossed horizontally by 5 lamellæ, labial side plaited vertically.

Height 0·068, greatest breadth 0·086, least breadth 0·073.

Named in compliment to Joshua Alder, Esq., of Newcastle.

Lindsleya Bridgesiana, Chitty.

Hab. Bodle's Pen Wood (high road to Clarendon), St. Dorothy.

Form, globose-conic. *Colour*, very pale horn. *Sculpture*, 19 strongly raised spiral carinæ; on the upper whorls 6. *Spire*, moderately elevated, with rather concave outlines. *Whorls*, $4\frac{3}{4}$, moderately rounded, with a moderate suture. *Aperture*, semicircular, very slightly expanded above, more so below. *Labrum*, scarcely detached from body-whorl, slightly produced above, pectinated and scolloped bluntly by about 15 of the carinæ. *Labium*, straight, except a slight curve below; moderately detached from the body-whorl, rather below the plane of the labrum in lower end. *Umbilicus*, deep. *Labral lamella*, rather produced at its junction with the labrum, moderately broad round the umbilicus. *Operculum*, moderately concave, a very few coarse granulations, with 8 or 10 very short raised lamellæ converging to, but not reaching, the centre, on the labral

side ; a linguiform sharp projection overlapping the lower extremity of the labium.

Height 0·06, greatest breadth 0·076, least breadth 0·063.

Named in compliment to Thomas Bridges, Esq., an able zoological and botanical collector, particularly in Chili and other parts of South America.

LINDSLEYA SALLÉANA, Chitty.

Hab. New Forest, Manchester (unique).

Form, globose-conic. *Colour,* —— ? *Sculpture,* 12 strong spiral carinæ, 2 fine in each interspace and 3 less strong round the umbilicus : on the upper whorls 4 corresponding fine ones. *Spire,* well elevated, with rather concave outlines. *Whorls,* $4\frac{3}{4}$, well rounded, with a deep suture. *Aperture,* slightly expanded above, more so below, scarcely detached from last whorl, more than a semicircle. *Labrum,* scarcely produced from body-whorl, not produced above, very slightly reflexed and thickened, coarsely pectinated by the strong carinæ. *Labium,* moderately detached from body-whorl, slightly curved throughout, on a plane with labrum. *Umbilicus,* broad and moderately deep. *Labral lamella,* much produced at its junction with labrum, below, sharp, and dipping abruptly into the umbilicus. *Operculum,* —— ?

Height 0·079, greatest breadth 0·092, least breadth 0·073.

Named in compliment to M. Auguste Sallé, an excellent zoological collector.

LINDSLEYA ARTHURIANA, Chitty.

Hab. John Crow Hill, Portland.

Form, globose-conic. *Colour,* light yellow. *Sculpture,* 31 raised spiral carinæ, not quite equidistant ; on the upper whorls 7. *Spire,* well elevated, with rather convex outlines. *Whorls,* $3\frac{2}{3}$, very well rounded, with a deep suture, last whorl very globose. *Aperture,* slightly and somewhat abruptly expanded, more than a semicircle, subelliptical, slightly depressed above and expanded below. *Labrum,* rounded into labium, more broadly below, very slightly produced above, double, white, smooth, not pectinated. *Labium,* scarcely detached from body-whorl, on a plane with labrum. *Umbilicus,* very shallow, broad. *Labral lamella,* scarcely produced. *Operculum,* slightly concave, very finely granulated in the centre.

Height 0·049, greatest breadth 0·066, least breadth 0·054.

Named in compliment to Arthur Adams, Esq., of London, the conjoint author with his brother Henry Adams.

This shell is like *L. Albersiana,* but differs in sculpture, number of whorls, and measurements.

LINDSLEYA GUTIEREZIANA, Chitty.

Hab. New Hope, Westmoreland.

Form, globose-conic. *Colour,* pale horn. *Sculpture,* 16 strong spiral carinæ, *only* about the periphery one fine intervening ; on the upper whorls, 5. *Spire,* well elevated, with straight outlines. *Whorls,*

5½, well rounded, with a deep suture. *Aperture*, less than a semicircle, very slightly spreading, and very slightly deflected below. *Labrum*, slightly separated from body-whorl, rather produced above, in a broad notch, pectinated by about 15 of the strong carinæ. *Labium*, well detached from body-whorl, curved inwards, more so below; thickened and reflected in the centre and its lower end towards the umbilicus. *Labrum* and *labium* continuous above; *labium* on a plane with labrum below. *Umbilicus*, deep. *Labral lamella*, sharply produced as it leaves the labrum, becoming narrow, and abruptly lost in the umbilicus. *Operculum*, ——?

Height 0·084, greatest breadth 0·15, least breadth 0·082.

Named in compliment to Señor Don Nicolas Josè Gutierez, Curator of the Museum at the Havanna.

LINDSLEYA OWENIANA, Chitty.

Hab. Yallahs Hill.

Form, globose-conic. *Colour*, pale horn. *Sculpture*, 19 strong, rather inequidistant spiral carinæ; on the upper whorls 6. Striæ of growth visible. *Spire*, moderately elevated, with rather concave outlines. *Whorls*, 4½, well rounded, with a deep suture. *Aperture*, semicircular, rather flattened above, slightly expanded in the lower two-thirds. *Labrum*, rather produced above, not reflected, thin, strongly pectinated by spiral carinæ. *Labium*, rather detached from body-whorl, gradually curved to the right below. *Umbilicus*, rather deep and broad, slightly hidden by the *labral lamella*, which is but little produced. *Operculum*, concave, finely granulated, with, on the labral side extending half across, 5 horizontal raised lamellæ converging towards the umbilicus, the margins of which are covered with fine granulations giving the appearance of serration; lower third laps tightly over the labium, grooved horizontally, and then finished by a linguiform, raised, folding projection.

Height 0·069, greatest breadth 0·094, least breadth 0·073.

Named in compliment to Professor Owen.

LINDSLEYA WOLLASTONIANA, Chitty.

Hab. ——? Hanover.

Form, globose-discoidal. *Colour*, white, semitransparent. *Sculpture*, about 31 very fine inequidistant, irregular, spiral, raised carinæ, about 8 rather stronger than the rest; on the upper whorls 8. *Spire*, slightly raised, with convex outlines. *Whorls*, 3¾, very moderately rounded, with a light suture. *Aperture*, slightly constricted behind labrum, and then slightly expanded, semicircular. *Labrum*, very little produced above, thickened and reflected and very slightly pectinated by the stronger carinæ. *Labium*, well detached from the body-whorl, moderately curved below, on a plane with the labrum. *Umbilicus*, moderately deep and wide. *Labral lamella*, narrow and sharp. *Operculum*, slightly concave, plain and smooth, except a few coarse granulations.

Height 0·036, greatest breadth 0·064, least breadth 0·05.

Named in compliment to T. Vernon Wollaston, Esq., M.A., so well known for his natural-history researches in Madeira.

Genus VIII. Blandia, Chitty.

Shell subdiscoidal, not prominently sculptured.

Blandia Blandiana, Chitty.

See *Stoastoma Blandianum*, Ad. Mon. Stoast. Adams, 1849, p. 6; Cat. Phan. p. 234.
Hab. Peace River, Manchester.

Blandia Jeffreysiana, Chitty.

Hab. Roaring River, Westmoreland.
Form, subdiscoidal. *Colour*, pale yellow. *Sculpture*, 22 fine, distant and nearly equidistant spiral carinæ, 5 interspersed being rather stronger; carinæ finer behind the aperture: on the upper whorls 6. *Spire*, very little elevated, with convex outlines. *Whorls*, $3\frac{1}{2}$, moderately rounded, with a slight suture. *Aperture*, constricted at a distance behind labrum, and widely expanded and cupping inwards at the labium, rather flattened above. *Labrum*, moderately produced above, treble in the upper part, broadly but not deeply scolloped, and pectinated by the 5 stronger carinæ, much thickened, white and shining. *Labium*, thickened and much reflected to the left at its edge, curved to the right below, widely detached from body-whorl, much below the plane of labrum. *Umbilicus*, very deep and broad. *Labral lamella*, rather strong. *Operculum*, very concave, margined with a broad convexly raised ridge something like *Wilkinsonæa Schomburgkiana*, with two deep, plainly-visible, indented grooves on the labial side; 5 sharp diagonal raised lines crossing from right above to left below on the labral side of the hollow.
Height 0·04, greatest breadth 0·063, least breadth 0·047.
Named in compliment to J. Gwyn Jeffreys, Esq., late of Swansea, now of London, a zealous conchologist and possessor of the finest British collection.

Blandia Bairdiana, Chitty.

Hab. Yallahs Hill.
Form, subdiscoidal. *Colour*, very pale horn or pure white. *Sculpture*, about 30 or 40 spiral carinæ, almost obsolete, scarcely visible under a $1\frac{1}{4}$-inch microscope, about 5 being rather more sharp than the rest; on the upper whorls about 7. *Spire*, very slightly elevated, with rather concave outlines. *Whorls*, $3\frac{1}{3}$, moderately rounded, with a slight suture; last whorl rather flattened at the periphery. *Aperture*, semielliptical, very much produced from the body-whorl, rather depressed above, but elegantly expanded throughout. *Labrum*, very much produced above, joining the body-whorl in a very graceful serpentine curving lamella (by which the shell may be distinguished), much thickened and reflected. *Labium*, mo-

derately detached from the body-whorl and thickened and reflected, slightly curved to the right below, very much below the plane of the labrum. *Umbilicus,* broad and moderately deep. *Labral lamella,* very sharp and narrowly produced. *Operculum,* deeply concave, apparently smooth, or with blunt vertical lamellæ, margined all round, labial side much curved, rather pointed at upper and lower extremity.

Height 0·033, greatest breadth 0·062, least breadth 0·052.

Named in compliment to my friend Dr. Baird, of the British Museum.

Var. *minor*. A much smaller variety, coming from the same habitat.

Blandia MacGillivrayana, Chitty.

Hab. (?) Pedro district, St. Ann's.

Form, subdiscoidal. *Colour,* pale yellow. *Sculpture,* 20 faint, equidistant, spiral carinæ; on the upper whorls, 6. *Spire,* very little elevated, with convex outlines. *Whorls,* $3\frac{1}{4}$, moderately rounded, with a moderate suture. *Aperture,* large, very broadly expanding, slightly depressed above. *Labrum,* double throughout, but more so above, slightly reflected, white, smooth, much produced above, leaving the body-whorl at an angle of about 50°. *Labium,* almost appressed to the body-whorl in its centre, slightly curved above, more below to the right, below the plane of the labrum. *Umbilicus,* shallow and spreading. *Labral lamella,* very little produced. *Operculum,* not concave, but moderately sunk or depressed (flat or smooth) in its interior surface, more so at the lower labial side; edge on labral side much and broadly folded over convexly.

Height 0·034, greatest breadth 0·055, least breadth 0·045.

Named in compliment to John MacGillivray, Esq., the well-known and able naturalist and collector.

Blandia Troscheliana, Chitty.

Hab. Clarendon Mountains.

Form, subdiscoidal. *Colour,* ——? (only two bad specimens). *Sculpture,* 23 irregular, inequidistant, coarsely rounded, spiral carinæ obsolete at the periphery, 4 more prominent than the rest; on the upper whorls, 5. *Spire,* much depressed, with convex outlines. *Whorls,* $3\frac{1}{2}$, well rounded, with a well-impressed suture. *Aperture,* very slightly expanded, rather flattened above and depressed below, more than a semicircle. *Labrum,* moderately produced above, double, white, thickened and reflected, very slightly pectinated by the four stronger carinæ, or rather squared as in *Wilkinsonæa Moussoniana*. *Labium,* well-detached from body-whorl, slightly curved to the right above and below, on a plane with the labrum below, lower above. *Umbilicus,* broad and deep. *Labral lamella,* very little produced. *Operculum,* smooth and concave, deep on the labial side.

Height 0·03, greatest breadth 0·059, least breadth 0·045.

Named in compliment to Dr. Troschel, of Bonn, Editor of the 'Archiv' of Natural History, &c.

Blandia Hilliana, Chitty.

Hab. ——?, Westmoreland.

Form, subdiscoidal. *Colour,* pale horn. *Sculpture,* 22 inequidistant spiral carinæ, wider apart and stronger above, and a few at the periphery most raised; on the upper whorls, 5. *Spire,* much depressed, slightly concave. *Whorls,* $3\frac{1}{2}$, moderately rounded, with a rather deep suture. *Aperture,* very slightly constricted at the fauces, slightly expanded, depressed above, more than a semicircle. *Labrum,* well produced above and pointedly, leaving the body-whorl at about an angle of 30°, white, slightly pectinated by about five points, thin, reflected. *Labium,* slightly curved below, well detached from body-whorl. *Umbilicus,* rather deep and broad. *Labral lamella* and *operculum,* like *Wilkinsonœa Bensoniana.*

Height 0·025, greatest breadth 0·047, least breadth 0·041.

Named in compliment to the Hon. Richard Hill, of Spanish Town, Jamaica, well known as an ornithologist and lover of general natural history.

Blandia Trailliana, Chitty.

Hab. Clarendon Mountains (unique).

Form, subdiscoidal. *Colour,* pale horn. *Sculpture,* 5 coarser spiral carinæ and 2 coarse; 6th to 10th coarse, with one coarse between, and after, each; 11th coarser, and 5 coarse round umbilicus; on the upper whorls, 5. *Spire,* much depressed, with convex outlines. *Whorls,* $3\frac{1}{3}$, well rounded, with a deep suture; last whorl well-rounded, large. *Aperture,* semicircular, slightly constricted at a distance from the labrum, and then elegantly and slightly expanded. *Labrum,* well produced above, and in an elegant curve, treble above and double below, as in *Helix Rupis-fontis* in my cabinet (N.B. since first describing this shell it has unfortunately got broken), very slightly thickened at its extreme edge, and white. *Labium,* moderately detached from body-whorl, wide and much reflected, curving slightly throughout, below the plane of labrum. *Umbilicus,* moderately deep and broad. *Labral lamella,* slightly produced. *Operculum,* ——?

Height 0·034, greatest breadth 0·057, least breadth 0·041.

Named in compliment to Dr. Traill (Malacca?), the great East Indian collector.

Blandia Lukisiana, Chitty.

Hab. Near Port Maria (unique).

Form, subdiscoidal. *Colour,* pale horn. *Sculpture,* 27 fine sharp spiral carinæ, the 6th, 10th, 15th and 23rd being rather stronger; on the upper whorls, 6. *Spire,* much depressed, with slightly convex outlines. *Whorls,* $3\frac{1}{3}$, moderately rounded, with a moderate suture. *Aperture,* slightly depressed above, expanded below, semielliptic. *Labrum,* produced above in a curve, leaving the body-whorl

in a quasi angle of about 80°, double and widely so above, pectinated by about 5 points, very slightly reflected, white. *Labium,* nearly straight, very little curved to the right below, slightly detached from the body-whorl, on a plane with the labrum above, lower below. *Umbilicus,* moderately deep. *Labral lamella,* rather produced in its centre. *Operculum,* —— ?

Height 0·024, greatest breadth 0·051, least breadth 0·04.

Named in compliment to Dr. Lukis of Guernsey, an able naturalist and antiquary.

BLANDIA LOWEANA, Chitty.

Hab. Bodle's Pen Wood, St. Dorothy.

Form, subdiscoidal. *Colour,* dark horn. *Sculpture,* spiral carinæ, 5 less and 1 strong repeated four times, then 5 less and 2 strong, then 3 fine and 1 strong, and 4 less strong ; on the upper whorls, 7 or 8. *Spire,* very slightly elevated, with slightly concave outlines. *Apex,* obtusely prominent. *Whorls,* 3½, very slightly rounded, with a deep suture. *Aperture,* more than a semicircle, rather expanded above, very slightly deflected and expanded below. *Labrum,* slightly produced above at the 1st and 2nd strong carinæ, broadly pectinated and scolloped by all the strong carinæ. *Labium,* well detached from the body-whorl, below the plane of the labrum above, slightly rounded and nearly up to the plane of the labrum in the lower end. *Umbilicus,* moderately deep. *Labral lamella,* very sharp and narrow. *Operculum,* deeply concave in the centre and minutely granulated ; two or three microscopic lamellæ crossing vertically, the edge all round thickened and deeply reflected outward, the upper edge having five or six deep irregular vertical folds.

Height 0·027, greatest breadth 0·055, least breadth 0·042.

Named in compliment to the Rev. R. T. Lowe, lately Chaplain in Madeira, and the well-known contributor to the natural history of that island.

November 10, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

NOTES ON AN UNNAMED PARROT FROM THE ISLAND OF ST. DOMINGO ; AND ON SOME OTHER SPECIES OF THE SAME FAMILY. BY PHILIP LUTLEY SCLATER, M.A.

M. Auguste Sallé has called my attention to the fact, that the White-fronted Parrot of San Domingo, commonly regarded as the immature state of *Chrysotis leucocephala,* is in truth quite a different species from that bird. It may be distinguished at once by having no red on the throat and a narrower white frontal band than the true *leucocephala,* which is from Cuba. M. Sallé, who has had ample opportunities of observing this bird in its natural state, is confident as to its distinctness, and I have no doubt he is quite right. Under these circumstances, I propose to call the San Domingan bird, which has not yet received a specific designation, *Chrysotis Sallæi,*—a just ribute to one who has made such extensive discoveries in the

natural history of the New World, and is the only modern naturalist who has explored the still imperfectly-known zoology of the island which it inhabits.

The true *Chrysotis leucocephala* is figured in Edwards's 'Gleanings,' vol. iv. pl. 166, as "*The White-fronted Parrot*," and by Buffon in the 'Planches Enluminées' as the "*Perroquet à front blanc du Sénégal*," and "*Perroquet de la Martinique*," nos. 335 and 549. It is also well represented by Le Vaillant as the male of "*Le Perroquet à face rouge*" (pl. 107 et 107 bis). It is included in the revised list of Cuban birds lately published in Cabanis' Journal; and specimens in the collection of the Academy of Philadelphia were procured by Mr. Richard Taylor in that island.

Examples of this bird likewise occur in the British Museum, and there is a specimen now living in the Society's gardens.

The *Chrysotis Sallæi* is figured by Buffon in his 'Planches Enluminées,' no. 548, as the "*Perroquet à ventre pourpre de la Martinique*." Specimens collected by M. Sallé in San Domingo are in the British Museum and at the Jardin des Plantes at Paris, and there are two fine examples now living in the Society's gardens.

There is likewise living in the Society's gardens an example of another nearly allied species of Parrot, which has also been sometimes confounded with the true *Chrysotis leucocephala*. This is the Red-fronted Parrot (*Chrysotis vittata*), figured in the 'Planches Enluminées' under the title of "*Perroquet de S. Domingue*," and often called by Gmelin's specific name "*dominicensis*." It is not, however, as far as I know, found in the island of Dominica, but in Puerto Rico, whence examples, now in the Museum of the Jardin des Plantes at Paris, were transmitted by Maugé. Le Vaillant has represented this bird as the female of his "*Perroquet à face rouge*."

Mr. Gosse's *Psittacus leucocephalus* from Jamaica, of which there is one specimen in the British Museum, seems different again, and ought probably to bear the name *Chrysotis vinaceicollis*; the bird described by M. de Lafresnaye as *Pionus vinaceicollis* (Rev. Zool. 1846, p. 321) being probably intended for the young of this; but a larger series of examples is perhaps requisite to confirm this species.

It is very interesting to notice how the different islands of the Antilles are thus tenanted by distinct, though corresponding, species of Parrots:—Cuba by *Chrysotis leucocephala* and *Conurus guianensis** (?), Jamaica by *Chrysotis vinaceicollis* and *Conurus nanus*, Puerto Rico by *Chrysotis vittata* and *Conurus Maugæi*†, and San Domingo by *Chrysotis Sallæi* and *Conurus chloropterus*‡.

While upon the subject of Parrots, I may add some notes taken during a late inspection of specimens of these birds in several museums.

Prince Bonaparte, in one of his last papers, proposed to call the

* Probably not the true *guianensis* of Guiana, but so called by Cabanis, Journ. f. Orn. 1856, p. 106.

† *Psittacara maugæi*, Souancé, Rev. et Mag. de Zool. 1856, p. 59.

‡ *Psittacara chloroptera*, Souancé, Rev. et Mag. de Zool. 1856, p. 59.

little Mexican Conure, which so nearly resembles *Myiopsitta tigrina* of Souancé, *Bolborhynchus catharina* (Compt. Rend. March 1857). But there is no doubt that the Mexican bird (whether really distinct from the Venezuelan *tigrina* or not) should bear the name *lineola* of Cassin. Mr. Cassin's type, which is in the Philadelphian Academy's Museum, was obtained by Mr. Pease, near Puente Naçional, in the State of Vera Cruz, and there is no ground for supposing error in the locality. I have seen the same bird in the collection of Dr. Cabot of Boston. It was obtained by him in Yucatan, in the island of Cosumel in 1842.

The Parrots belonging to the genus *Tanygnathus* of the East Indian islands are in much confusion, which a more accurate knowledge of the localities whence specimens are brought would, I think, soon clear up. The type of the genus, *Tanygnathus macrorhynchus* (Pl. Enl. 713), distinguished by its enormous blood-red beak and green head, with the wings varied with black and yellow, is said to be from New Guinea. This is very likely to be the case, but more certain localities are the islands of Gilolo, where examples were procured by Forsten, and Ceram, where Reinwardt found it living, as I learn from the marked specimens in the Leyden Museum. Next to it comes *T. marginatus* (Pl. Enl. 287, *fig. mala*) from the Philippines. This species has the hind part of the head blue, and the wings varied with yellow and blue. A third bird of this genus is *Tanygnathus Mulleri*, Bp. Consp. p. 5, et Müll. et Schlegel, Verh. Ned. Ov. Bez., Land en Volk. p. 108. The type-specimen of this bird (which is in the Leyden Museum) was brought by Müller from the island of Bouton; but the same species occurs near Macassar, in the adjacent island of Celebes, whence Mr. Wallace has lately transmitted specimens; and living examples in the Zoological Gardens at Rotterdam are said to be from Timor.

We have now living in the Society's gardens examples of *Tanygnathus macrorhynchus* and *T. Mulleri*.

In our gardens we have also now living another very interesting bird, namely the large green Lory, described by Prince Bonaparte in a note in our 'Proceedings' in 1850 (p. 26) as *Psittacodis Westermanni*, which may be easily distinguished from its near ally, the *Psittacus magnus* or *sinensis* of the older authors (of which we have also a living specimen), by the want of the red patch on the flanks, as well as by the different hue of the deep green colour. Prince Bonaparte has employed for these birds, which, as he well remarks, form the only *green* genus of true Lories, the term *Psittacodis*. But the true type of *Psittacodis* (as constituted by Wagler*, its originator) is the extraordinary Parrot, *Psittacus paragua*—a distinct form altogether, to which Prince Bonaparte has applied the name *Stavorinius*. Mr. G. R. Gray, in his last List of Genera (p. 88, genus 1491), applies the term *Mascarinus* to these Parrots. But Lesson's name *Mascarinus* cannot, I think, possibly be used otherwise than for the *Psittacus mascarinus* of Madagascar, which Lesson placed within the genus, although he did not arrange it as the first

* Wagler, Mon. Psittacorum, p. 495.

species. It seems quite absurd to call a group of birds occurring only in the Moluccas "*Mascarinus*." I therefore suggest the adoption of the term "*Polychlorus*," given by Scopoli as the specific designation of *Psittacus magnus*, as a generic name for these birds—which will so stand as *Polychlorus magnus*, and *Polychlorus Westermanni*; and the third species, Prince Bonaparte's *Psittacodis intermedius*, of which there are examples in the British and Leyden Museums—as *Polychlorus intermedius*.

It is singular that the only other known example of *Polychlorus Westermanni*, from which Prince Bonaparte's description was taken, is also a living bird in the Zoological Gardens of Amsterdam, where the collection of *Psittacidæ* (which I had the pleasure of inspecting a few weeks since) is very good, embracing about sixty-four species.

It is however surpassed by that in our own Gardens, where at the present moment no less than seventy-five species may be seen living.

On Siphonognathus, a new Genus of Fistularidæ. By Sir John Richardson, F.R.S., Hon. F.R.S.E. etc.

Siphonognathus, gen. nov.

Facies elongata, fistulosa, Aulostomatum, *ex osse nasali et frontali, ossibusque palatinis, preoperculis, pterygoideis cum tympanicis productis formata. Præmaxillaria sub lateribus ossis nasalis, fere immobilia. Rictus oris mediocris, horizontalis in rostro extremo, motu solo cardinali mandibulæ subincurvæ aperiens et claudens. Maxillæ pars descendens, gracilis in disco parvulo subrotundo ad angulum oris expansa. Labia præmaxillaria et mandibularia arcta, super ossa propria replicata : priora ex utroque latere ante os nasali approximantia coalescentiaque et filamentum parvulum, impar, terminale, gracile præ ore instar proboscidis dependens, efficientia.*

Foramina narium utrinque bina in acie faciei ad oculum approximata : apertura anterior, operculata, vix oculo nudo discernenda, posteriori hianti nec marginatæ vicina. Dentes omnino nulli. Pharynx angusta, lævis. Cranium nec cristatum nec spinosum. Apertura branchialis obliqua, infra antrorsum tendens. Ossa branchiostega quatuor utrinque, gracilia. Branchiæ quatuor. Vertebræ costiferæ 29–30 *circiter. Costæ breves, graciles.* (*Vertebræ caudales non numeratæ.*) *Anus pone medium.*

Squamæ cycloidei læves, ovales, in tempora, genas et occiput procurrentes ; vultus esquamosus, lævis. Forma corporis elongata, subcylindrica ; caudæ pyramidata.

Pinnæ ventrales nullæ. Pinna caudæ cordato-lanceolata, acuminata. Pinnæ pectoris radiis paucis apicibus simplicibus, planis non dilatatis. Radii anteriores pinnæ dorsi, elastici, non pungentes, nec tamen articulos ostendentes. Pinnæ ani radius primus eodem modo subspinosus. Radii omnes pinnarum simplices membrana tenui connexi.

Intestina simplex, sine versura rectè in anum tendens; dilatatio ventriculi parva. Cæca pylorica nulla nobis detecta. Vesica pneumatica ampla.

Siphonognathus argyrophanes.

In general form this fish approaches *Aulostoma*, the structure of the head and the tubular elongation of the palate and os hyoides being similar. The body is less compressed, being roundish, but yet with somewhat flattened sides, and a slight tapering towards the anus. The compression increases in the tapering tail. As in *Aulostoma*, the great length of head is due to the prolongations of the prefrontals, palatines, vomer, nasal, pterygoids, tympanics and hyoid bones, constituting a tube terminated by the horizontal opening of the mouth. The premaxillaries form the upper border of the mouth, and have little or no motion. They conceal the slender limb of the maxillary, but the irregularly triangular or small suborbicular plate of the latter protects the corner of the mouth. Equal in length to the maxillaries, the mandible is articulated to the extremities of the tympanics, and is slightly curved, producing a lateral gaping when the mouth is closed. Both it and the premaxillaries are edged by narrow lips which fold back on the limbs of their respective bones. At the extremity of the snout the premaxillary lips unite to form a fine awl-shaped proboscis-like barbel, which hangs down before the mouth. No teeth whatever could be discovered in the jaws or in the tubular mouth,—not even in the pharynx, which is narrow. Form of the head a slender four-sided obelisk, the space between the eyes being occupied by the forked mid-frontal, into which the nasal is dovetailed. The latter as it runs forwards is feebly convex, and shows a smooth and scarcely prominent medial line, which terminates in the slightly swelling extremity of the bone and of the snout. Under each edge of the nasal, the long slender premaxillary appears as already mentioned. On the sides, the facial tube is completed by dark brown membrane, and on the ventral surface also a membrane stretches from the interopercula and tympanics of one side to those of the other, being supported on the mesial line, interiorly by a very slender lingual bone, which is neither prominent nor covered with flesh so as to form a tongue. Continuous with this under-surface of the mouth follows the branchiostegous membrane, whose deeply crescentic distal edge makes no flap at the isthmus to which it is attached. Four slender, moderately long, elastic branchiostegals support the membrane on each side. One specimen, it may be noticed, has only three branchiostegals on the right side. The gill-plate is connected to the nuchal region by scaly membrane, and terminates in a small flexible strap-shaped apex, above which only a small corner of the gill-opening appears, nine-tenths of the opening being below it. No bony crests or spinous points exist on the cranium. The nostrils are on the edge of the head, close before the eye, the hinder one being an open pore, not above a line from the orbit, and the other is situated a quarter of an inch before it in a pulpy membrane, and being closed

by a flap is not very perceptible. The space between each pair is of course equal to the breadth of the head in that region.

Scales cycloid, oval, most of them oblique, or unequal at the base, of moderate size and delicate texture, showing very fine concentric lines of structure, and from five to fifteen faint basal grooves. Scaly integument covers the upper half of the operculum, and also a rectangular space bounded anteriorly by the vertical limb of the preoperculum and the eye. On the top of the head the scales end by a crescentic line, whose ends touch the angles at the eye. The facial part of the head is clothed with scaleless integument, and there are many pores and mucous canals extending along the under edge of the prefrontal. A soft tubular ring supplies the place of suborbital bones, and the small preorbitar scale bone is almost membranous, but becomes rough in drying, from the number of mucous canals which run through it. Between the gill opening and the caudal fin, there are 102 scales in a longitudinal row, six rows above the lateral line, and nine below it. The lateral line is formed by a row of small pores, each placed on the tip of a small scale, of whose disk little appears, because of the overlapping of the adjoining scales above and below. A taper-pointed scale terminates the scaly integument on the base of the caudal on each side.

Fin-rays.—Br. 4—4; D. 23|23, last two approximated at the base; A, 2|13, last two approximated at the base; C. 17; P. 10; V. 0. Dorsal commencing over the bones of the pectorals and just behind the tips of the gill-covers. It runs considerably past the anus, and some way further than the anal, its outline being even, though rising slightly in its course. Its rays are simple and unbranched like those of the other fins (except the caudal), and half of them are without visible joints, elastic at the base and tapering with flexible points. The anal commencing near the anus does not reach so far down the tail as the dorsal. It is composed of similar rays, and in the anterior two the joints are obsolete. The caudal, semilanceolate at the base, tapers to a slender, very acute point. Its rays are sparingly divided at the tips. Pectorals supported by ten simple rays with flattened but not dilated tips. No ventrals.

The intestines of the smaller specimen were examined, but not satisfactorily, as they had received injury, particularly the air-bladder, from a glass rod that had been thrust down the throat of the fish. The alimentary canal is quite straight and simple, with a slight widening below the œsophagus, but no defined stomach. No pyloric cæca were detected. The inside of the gut was thickly lined by a fine, flocculent mucus-like matter, and on scraping it away a multitude of longitudinal striæ were seen extending along the inner membrane. The liver, partly perished, was on the right side, and did not descend far. Air-bladder torn, so that its size and form could not be ascertained. It appeared to have been large, and its coats to have been soft, fibrous, and nacry, and though thick, very readily torn. The melt was enclosed in a delicate capsule with a long seminal duct.

Under the lateral line there is a bright silvery stripe extending the

whole length of the fish, and above it a stripe of equal breadth of a brownish-purple colour. This stripe reaches the tip of the caudal in one direction, and in the other passes over the upper part of the gill-cover, along the sides of the head to the mouth. Above, the back is of a lighter brown, and along the base of the caudal there is a purplish-black line. These colours are described as they exist after two or three years of maceration in spirits, and they have doubtless undergone alteration since the fish was taken.

Science is indebted for this novel and highly interesting form of fish to the late Captain Sir Everard Home, who never lost an opportunity of adding to our natural-history collections. He obtained it in King George's Sound. Some half-digested pieces of fish were found in the mouth, but nothing except mucus in the intestines.

Dimensions.

	Inches.
Length from tip of the snout to extremity of caudal, exclusive of rostral barbel	16·50
——— from tip of the snout to tip of the gill-cover	4·80
——— from tip of the snout to fore-edge of the orbit	3·00
——— from tip of the snout to anus	10·00
Distance between the orbits	0·38
Length of diameter of the eye	0·45
——— of rostral barbel	0·62
——— from posterior angle of the eye to the tip of the gill-cover	1·43
——— of the opening of the mouth	1·10
Height of the head behind the preoperculum	0·65
Greatest breadth of shoulders or nape	0·70
Height of body behind the pectorals	1·00
Length of naked space between dorsal and caudal	2·00
——— of caudal fin	2·50
——— of attachment of anal fin	1·80
——— of pectorals	0·95
Height of posterior dorsal rays	0·80

November 24, 1857.—J. Gould, Esq., F.R.S., V.P., in the Chair.

On Four New Species of Mus and one of Hapalotis from Australia. By John Gould, F.R.S., V.P., etc.

Mr. Gould alluded to the prevailing opinion that none but Marsupial animals were to be found in Australia, and observed that this opinion may be correct to a certain extent, yet the *Placentalia* are well represented in that country by numerous species of the genera *Hapalotis, Mus,* &c.; and remarked that in few countries are the smaller members of the *Rodentia* more abundant both in species and individuals. It is to this latter order that the four new species now exhibited by him pertain.

For the first of these he proposed the name of *Mus assimilis*; this animal is about the same size as the *Mus decumanus* of Europe, and

has a very similar aspect; its hair, however, is more soft and silky, and its incisor teeth very long and narrow.

MUS ASSIMILIS.

Face, all the upper surface and sides light brown, very finely pencilled with black; under surface greyish-buff, the base of the fur all over the body dark slaty-grey; whiskers black; tail nearly destitute of hairs; all the feet clothed with very fine silvery-white hairs.

Total length from nose to base of tail....	$7\frac{1}{4}$	inches.
———— of the tail	6	,,
———— of fore-arm	1	,,
———— of the tarsus and toes......	$1\frac{1}{4}$	,,

Remark.—The minute silvery-white hairs of the feet give these organs a very delicate appearance; yet they are not positively white, neither are they brown.

The two specimens from which the above description was taken and to which the remarks refer are from the banks of the Clarence in New South Wales, where they were procured by the late Mr. Strange. Three other specimens collected by Mr. Gilbert at King George's Sound differ only in being about a fifth smaller in all their admeasurements; it is just possible that it will hereafter be found that these latter animals are distinct from the former, but at present they are regarded as identical; and if such be the case, the range of the species extends along the whole southern sea-board of the continent from east to west.

The second species is a short, robust, compact Rat, equal in size to the common Water Vole of England (*Arvicola amphibius*), but rather smaller than the *Mus fuscipes* of Australia. It is in every respect a true *Mus*, and is an inhabitant of the open plains of Darling Downs, New South Wales; its incisor teeth, when compared with those of *M. assimilis*, are broad and less elongated; its hair also is coarser and more wiry. Its colouring is as follows:—

MUS SORDIDUS.

Head, all the upper surface and flanks clothed with a mixture of black and brown, the former hue prevailing along the centre of the back, and both nearly equal in amount on the flanks; whiskers black; under surface greyish-buff; hind feet silvery-grey; fore feet greyish-brown; tail thinly clothed with extremely fine black hairs.

Total length from nose to base of tail....	$6\frac{3}{4}$	inches.
———— of the tail	5	,,
———— of the fore-arm	$\frac{3}{4}$	,,
———— of the hind-leg and toes....	$1\frac{1}{2}$	,,

Hab. Open plains of Darling Downs.

Remark.—The name of *sordidus* has been assigned to this animal from the dark colouring of its upper surface.

The third species to which Mr. Gould called attention is a remarkable black Rat, of nearly the same size as, and of a similarly delicate

form to, the Black Rat of Europe (*Mus Rattus*), from which it differs however in having the tip of the nose, the front part of the lips, a longitudinal stripe on the breast, the hind and fore feet, white. For this he proposed the name of

Mus manicatus.

Head, ears, and all the upper surface black, gradually passing into the deep grey of the under surface; nose, fore part of the lips, stripe down the centre of the throat and chest, hind and fore feet, white; whiskers deep black; tail denuded of hairs.

Length from nose to base of tail	7 inches.
——— of the tail	5 ,,
——— of the fore-arm	$1\frac{1}{2}$,,
——— of tarsi and toes	$1\frac{5}{8}$,,

Hab. Port Essington.

Remark.—This animal was presented to Mr. Gould by J. B. Turner, Esq.

The fourth is a very diminutive Rat, with coarse hair and a somewhat short tail; it is even smaller in size than the *Mus Gouldi* and *M. gracilicauda*, but is more nearly allied to the latter than to any other. Three or four specimens, all of the same size, are contained in the collection at the British Museum, and there are others in the Derby Museum at Liverpool, all of which were collected by Mr. Gilbert on the Victoria Plains, Western Australia.

Mus nanus.

Head, all the upper surface, flanks, outer sides of the limbs, and hairs clothing the tail, brown, with numerous interspersed fine black hairs; under surface greyish-white, becoming much lighter and forming a conspicuous patch immediately beneath the tail; whiskers black; feet light brown; base of the whole of the fur bluish-grey.

Length from nose to base of tail	4 inches.
——— of the tail	$3\frac{1}{4}$,,
——— of the fore-arm	$\frac{1}{2}$,,
——— of the tarsus and toes	$\frac{3}{4}$,,

This animal is known to the Aborigines of Moore's River in Western Australia by the name of *Jilbeetch.*

On the part of Dr. Gray, Mr. Gould brought under the notice of the Meeting a new and very distinct species of *Hapalotis*, which is nearly allied to, but considerably exceeds in size, the *Hapalotis melanura.* This animal was collected by Mr. Elsey in the interior of Australia during the recent expedition from the north-west coast of Australia to Moreton Bay. It is a harsh wiry-furred animal, and differs from *H. melanura* not only in size, but in the apical half of the tail being white.

Hapalotis hemileucura.

Head, all the upper surface and flanks very light sandy-brown,

with numerous, but thinly placed, fine long black hairs; under surface buffy-white, with even lighter feet and fore-arms; tail brown, deepening into black about the middle, beyond which the apical portion is white; the white hairs being prolonged into a small tuft at the tip.

Length from nose to base of tail	8 inches.
——— of the tail................	$6\frac{1}{2}$ "
——— of the fore-arm............	$1\frac{1}{2}$ "
——— of the tarsus and toes	$1\frac{1}{2}$ "

GEOLOGICAL SOCIETY.

December 16, 1857.—L. Horner, Esq., V.P.G.S., in the Chair.

"On a remarkable Fossil Specimen belonging to the Genus *Neuropteris*, from the Coal-measures of Lancashire, and Remarks on that Genus." By C. J. F. Bunbury, Esq., F.R.S., F.G.S.

The author begins by noticing the comparative rarity, in a fossil state, of the young half-expanded fronds of Ferns, showing the characteristic *circinate vernation*; and he remarks that the specimens in that state, hitherto figured, belong to the genus *Pecopteris*. He then describes a well-characterized specimen of *Neuropteris* in this circinate condition; it appears to belong to *N. gigantea*, or a variety of it, and was procured from Oldham in Lancashire. This specimen affords a strong confirmation of the opinion, that the fossil Neuropterides were really Ferns, which some have been tempted to doubt, in the absence of any knowledge of their fructification. This specimen shows that they had the characteristic vernation of Ferns; in particular, it shows a striking agreement in structure with the young fronds of *Aspidium exaltatum*. It is thus clear, at any rate, that *Neuropteris* did not belong to the Coniferous Order, in which there never is any approach to the circinate vernation: even in *Salisburia*, the leaves of which have, in their form and veining, so much the appearance of a Fern, their arrangement in the young state is quite different. The only flowering plants which can be compared with Ferns in this respect are the Cycadeæ; and in the absence of fructification it is not easy to prove positively that *Neuropteris* may not have belonged to that family. It is most probable, however, from the composition of the frond, the veining, texture, and all the characters together, that these fossil plants were true Ferns. To determine their nearest affinities in that family is hardly in our power, as there seems to be no constant relation between the vernation or other external characters and the fructification.

The genus *Neuropteris* is chiefly characteristic of the Coal-measures. The author has scarcely seen a genuine species of it from any formation later than the Trias, unless we except the enigmatical Anthracitic beds of the Alps, which afford several species apparently identical with those of the Coal. The Oolitic species referred to this genus by Lindley and Hutton do not agree with its characters. Two

species, *Neuropteris Loshii* and *N. tenuifolia*, appear to be common to the Carboniferous and Permian systems.

The author then points out, that, owing to the variations in different parts of the same frond (variations corresponding to those in many recent Ferns), the described species of *Neuropteris* have been too much multiplied; and he concludes with critical observations on a few of them.

MISCELLANEOUS.

Remarks on the Zoë *of* Eurynome aspera, *and the Habits of the Animal in Confinement.* By Prof. Kinahan.

The passage of the majority of the higher Crustacea through the Zoë state is now a recognized fact in zoology, and fresh species are turning up almost daily as Zoës. The present case is an example of this, as the Zoë of any of the Lambridæ, as far as I know, has never been described.

The specimens from which the ova were obtained were captured during one of the minor excursions of the British Association, in a dredging party, formed through the kindness and liberality of that well-known and indefatigable naturalist, Robert M'Andrew, Esq., consisting of Professors Allman, Archer, Redfern, Rev. P. Carpenter, of Warrington, Robert M'Andrew, Esq., and son, Dr. Edwards, Mr. Hyndman, and myself. The scene of our labours was the Kish Bank, where, in addition to many other Crustacea, five specimens of *E. aspera* were obtained, two of them loaded with spawn.

These I placed in a small salt-water tank, changing the water occasionally. They were first placed in the tank on the 1st of September; the ova then being of a bright salmon colour. On the 7th I found that the ova in one of them had become much darker, being of a dirty drab colour under the microscope, but little change could be detected in the appearance of their contents. On the 10th the ova were of a much darker drab, and the black eyes of the Zoës plainly distinguishable by the naked eye. The parent had all this time most assiduously kept up a perpetual current around and through the ova, seemingly by means of the pedipalps, at the same time keeping the mass in constant vibration by rhythmical up-and-down motions of the abdominal false feet, to which the ova were attached. She also sought the sunny side of the tank more than her wont now is. On the evening of the 12th the Zoës could be distinguished coiled up in the ova, fully formed, and the motions for aëration were very vigorously carried on; and on examining the tank on the morning of the 13th, I found it completely filled with many thousands of Zoës, which kept together in one continuous swarm at the side nearest the light. These gradually increased in size, and also altered in their form, seeming so active and healthy, that I was in hopes I might have been able to trace their complete changes; but unfortunately the second specimen

of *E. aspera* died on the evening of the 17th, poisoning the tank, so that on the morning of the 20th I found my poor Zoës dead, putting a stop to experiments as far as they were concerned.

The parent crab, however, still continues in health and vigour, although the water has not been changed for the last six weeks, and does not now consist of more than two pints in a circular tank, six inches in diameter, and although two green crabs, *C. mænas*, during the time died from the poisonous effects of impure water. Its habits are interesting: it is but a sedentary animal; it seeks the light occasionally, generally, however, keeping to the shadiest part of the tank. At night it is most active, running over the sides and bottom of the tank after the lights are extinguished, the noise it makes being considerable as it rattles over the glass. Its mode of feeding is sometimes most amusing. On its back, completely concealing it, is a large mass of sponge, which of course the crab carries about with it everywhere; it, however, causes these strange passengers to pay toll occasionally, as I have frequently seen the *E. aspera* stretching its long anterior limbs backwards, over its carapace, and, deliberately tearing off a portion of the sponge, coolly proceed to tuck it in between its jaws: sometimes holding the piece of sponge in one of the chelæ, it daintily tears off small pieces from the mass, which it then quietly devours. I detected it once feasting on a little Varying Hippolyte, *H. varians*, which was in the same tank; but generally speaking, its food must consist of the Entomostraca and other minute animals, &c., which abound in the water, and possibly also the Ulva. It is a most sluggish animal, slow and deliberate in its movements, and during the day remains with its back to the light in a lair it has formed under a projecting piece of *Ulva lactuca*, its long and beautifully carved arms kept semiflexed at some distance from each side of its body; and the whole animal perfectly motionless, except an occasional vibration of the foot-jaws, looking like some monster in his den. The species is not uncommon in moderately deep water on the banks around the coast, and I would recommend it as a good species to those who keep tanks, as it is generally tenacious of life, and bears travelling well, living for a long time, even in a small quantity of water.

My tanks, in which I have succeeded in keeping many of the rarer Crustacea, are so convenient, and their arrangement so simple, that I am tempted to describe them. They consist of a number of what are ordinarily called propagating-glasses (the dealers call them 'pro'-glasses'), six inches in diameter, and nine inches high; the only thing placed in them besides the water is the *Ulva lactuca*, selecting a broad piece unattached to stones, as I find that stones harbour dirt; the sea-weed must be a large piece, as one of its chief purposes is to afford cover and shelter to the animals from the light. It requires to be occasionally renewed, as the animals feed on it. I seldom introduce Mollusca of any kind, as I find them troublesome by dying at unexpected times, and thus poisoning the tank, and I have never seen any occasion for their services in keeping my tanks either clean or healthy.

In this same tank I have had at various times, under the above conditions, the following rare Crustacea:—

Thia polita, for four months.
Perimela denticulata, two months: hatched Zoës, and was itself killed and partially devoured by *Thia.*
Hippolyte Cranchii, one month.
H. pusiola, one month.
Crangon fasciatus, three weeks: all killed by *Thia.*
The Varying Prawn (*P. varians*), two months.
Squill Prawn (*P. squilla*), two months.
Common Shrimp (*C. vulgaris*), three weeks.
Hippolyte varians, three months.

Most of them died merely through neglect in changing the water, which I generally do not oftener than once a month. The tank is kept in a shady place, and uncovered, and the animals are but seldom fed, and then as often on small snails or wood-lice as anything else. The sea-water for change is kept in a large bottle with a narrow neck and transparent sides, closely corked, and sometimes, when used, has been three months or upwards in the bottle; so that the keeping of marine animals of the crustacean group is not such a difficult task as is commonly supposed.

The Zoës differ from those of *Cancer pagurus* in having no lateral or frontal spines on the carapace, and in having no spines at the inner angle of each joint of the abdomen below. The carapace is also very large; the abdomen is divided into six rings; the thoracic limbs are three (?), the most anterior hardly to be distinguished in form from the external foot-jaw of many of the Porcellanidæ.—*Proc. Dubl. Nat. Hist. Soc.*, 4th December, 1857.

On a new species of Barbet from the Upper Amazon. By P. L. Sclater, M.A., F.L.S., &c.

Eubucco aurantiicollis, sp. nov.

Viridis, pileo et mento summo intense sanguineo-rubris, torque cervicali postica clare flavicanti-viridi: cervice antica aurantia; pectore coccineo, ventre flavo et viridi strigato: rostro flavo, pedibus nigris.

Long. tota 5·5, alæ 2·6, caudæ 1·9.

This beautiful species of Barbet closely resembles *E. Richardsoni* figured in Gray and Mitchell's Genera of Birds, but may be distinguished by its light green posterior neck-band, orange and not lemon-yellow throat, and deeper scarlet breast. Mr. Bates has transmitted five examples from the Rio Javarri, which are all alike. The *Eubucco Richardsoni* is from New Grenada (Bogota collections).

The British Museum contains an example of this new species, collected by Hauxwell on the Ucayali in August 1852 and marked "Irides red."—*Proc. Zool. Soc.* Nov. 24, 1857.

On the Petrified Forest of Radowenz near Adersbach, and upon the Process of Petrifaction. By Professor GÖPPERT.

In the vicinity of the district of Adersbach, so remarkable for its wonderfully shaped sandstone formations, there is yet another natural curiosity, which, although less striking to the eye, merits no less consideration in a scientific point of view, namely *a magnificent deposit of petrified trees, such as has never yet been observed, at least in the coal-measures*, either in Europe or in any other part of the earth.* From Rohnow, a small town in Bohemia, on the western boundary of the county of Glatz, four and a half English miles from Cudowa, an elevated ridge, consisting of carbonaceous sandstone, striking in a westerly direction as far as Slatina, rises above the villages of Wüstkosteletz, Mystrey, Gipka, and Kliwitz; it is regarded as the overlying sandstone of the subjacent carboniferous rocks, and rises to its greatest elevation at the Oberberg of Slatina, a point affording a beautiful panoramic view. In this chain of hills, eleven miles and a half in length, and on an average two miles and a quarter in breadth, which is, for the most part, covered with forest, numerous petrified trunks occur, partly on the high ridges, partly in and on the numerous springs and rivulets which issue from these, and also on the borders of woods, roads, and fields, but especially in the environs of Radowenz, a village situated about two leagues from Adersbach, and united with the latter point by a pretty good road; also near the Bränden, and on the Oberberg of Slatina, where there are points from which at least 20,000 to 30,000 hundredweights of petrified wood may be surveyed at one glance, and whence all the museums of the world might be furnished with splendid specimens, such as they hardly possess at present. M. Benedict Schroll, a merchant and manufacturer in the neighbouring town of Braunau, who is engaged in the careful study of the very interesting palæontological conditions of the surrounding district, and has furnished me with much new information, especially with regard to the Permian formation, first informed me of this phænomenon, which I visited twice in the course of last summer in company with him and Drs. Beinert and Gebauer, but without exhausting it, as petrified trunks are not wanting in the district of Schadowitz lying to the south. The trunks themselves, which are almost always deprived of their bark, are from one to four feet in thickness, and from two to six feet long; round or roundish oval, often in longitudinal fragments as if split in two; all the specimens having horizontal, nearly even-fractured surfaces, but always with sharp angles, without traces of having been rolled about; of the brownish-grey colour of chalcedony, and a texture like hornstone; sometimes hollow in the middle, like trees of our present world, of which the summits have withered; also spirally twisted at an angle of three to

[* The tree-bearing sandstone described in this paper has been regarded by some geologists as being more probably a member of the Permian than of the Carboniferous series, and to be the representative of the tree-bearing Roth-liegendes of Chemnitz and Kyfhaüser.—ED.]

four degrees, and often furnished with large cicatrices of branches; they are consequently only fragments, scattered about in those localities during the cultivation of the forests and fields, of stems which very probably occur in the interior of the sandstone rock, from which they only project singly. Smaller stems or branches, of less than one foot in thickness, are wanting; and it is remarkable that I have never found any such in the carboniferous formation, whilst in the petrified forests of the tertiary formation, for example, in Egypt and Java, these are even more abundant than the larger ones. They all belong to coniferous plants, similar to the *Araucariæ*; one of them decidedly is a new species, *Araucarites Schrollianus* (named in honour of M. B. Schroll), and the other is *A. Brandlingii*, which has been found in the carboniferous strata of England*, Saarbrücken, Bohemia, and Silesia. I obtained a specimen of the former species, six feet in length and three feet in thickness, from M. Schroll; it is now an ornament of the Palæontological portion of the Botanic Garden at Breslau.

As regards the process of petrifaction itself, the previous experiments and observations mentioned by the author in the years 1836 and 1837, at the meetings of German Naturalists at Jena and Prague, and in the 'Fossil Flora of Silesia,' published in 1844, were, at the reading of this paper before the Silesian Society, Nov. 27, 1857, brought together with his more recent ones, and illustrated by the exhibition of specimens. The former started from woods discovered in the existing world, petrified by carbonate of lime or oxide of iron, to which native copper has very recently been added as a petrifying medium, as this has filled up cells and vessels in a fragment of beech-wood communicated to me by my honoured friend Haidinger. The examination of fossil woods shows, that after they are filled up by the various petrifactive media (carbonate of lime, silica, the various forms of oxides of iron and copper, cinnabar, baryta, gypsum, lead-glance and clay), in by far the greater number of cases, notwithstanding the solid, perfectly mineralized appearance of the exterior, a larger or smaller quantity of cells and vessels are still present, which, probably in consequence of the long duration of the process, have become changed into brown-coal, although retaining the cellulose here and there; hence the prevailing brown colour of petrified woods, which, however, are still frequently tinged in various ways by oxide of iron. Other differences, which can only be hinted at here, may be explained by the state in which they were at the time of fossilization. We need only refer to the infinitely variable texture of the woody plants of an existing forest. A complete displacement of the organic parts very rarely takes place, as perhaps in the so-called pyritized woods, and woods mineralized by brown iron-stone, as also in the crystalline wood-opals of Hungary, Bohemia, the Rhine districts, &c., and there in consequence of a process of decomposition of the organic matter. In the latter, cells still occupied by air-bubbles are often found.

In conclusion, the process of solution of the petrifactive minerals

[* *Dadoxylon Brandlingi* of Morris's 'Catalogue of British Fossils.'—Ed.]

was taken into consideration, and a great dilution of the solutions assumed, because otherwise the petrifaction would be prevented and incrustations produced; and at the same time reference was made to the remarkable and hardly explicable phænomenon, that with all the similarity of the processes of a former world with those of the present one, and notwithstanding the petrifactions by lime and oxide of iron now observed, still no siliceous petrifactions have been discovered, although in living plants, or at least in particular parts of them, silicifications take place in a comparatively very short time, and indeed in the same way as formerly in fossil woods, as in the epidermis of the stem of the Equiseta, in the Bamboos, the seeds of many Grasses, and above all, in the exceedingly remarkable tree called *El Cauto*, discovered by Krüger in Trinidad, in which, after the cells are filled, even the organic walls at last disappear, and become replaced by silica. All this, and many other circumstances are in favour of the former existence of conditions which have hitherto escaped our observation.—*Abstract of a memoir read before the Silesian Society*, Nov. 27, 1857.

Structure and Development of the Flower and Fruit of the Pear. By J. Decaisne.

From a communication made to that active association, the Botanical Society of France, we learn that Decaisne has proved, by direct observation of the development, the correctness of that view respecting the structure of the pomaceous fruit which we have always maintained on general morphological grounds. The pips are the true pistils; they are separate and free at their first appearance; a little later, a growth from the receptacle forms an open cup around them, ends by completely investing them, and becomes the flesh of the core. In the Pear, as the base of the at first sessile flower-bud elongates into a peduncle, the upper part of this thickens with the bud itself, and forms the tapering lower part of the Pear, which therefore below the carpels is formed of the stalk, as absolutely as in *Anacardium* or *Hovenia*. From these observations, and others upon *Melastomaceæ*, &c., Decaisne concludes that the orthodox view of the structure of the flower, "as explained by our illustrious masters, R. Brown, De Candolle, and Jussieu," is demonstrably correct; that "it is not necessary to call into account that axis which is at the present day so often and so willingly appealed to for explaining the structure of flowers and fruits;" that "it is not impossible to bring under the common law of organization the ovaries with a free central placenta, whose differences from ordinary ovaries are more apparent than real;" and that most probably placentation always, in spite of appearances, belongs to the ovarian leaves. We are pleased to find that the experience of this eminent botanist has brought him into agreement, as regards the conception of species, with the views of those whom we must regard as the soundest workers and writers of the present day, and those on whom the hopes of the science rest. He states that if he had the *Plan-*

tagineæ to elaborate anew, he should not hesitate to reduce considerably the number of species, "and perhaps to refer some entire sections to a single specific type." Perhaps even the greater part of two sections, we may add; for of two sections in the 'Prodromus,' one is founded upon substerile and the other upon truly fertile forms of the same species, or set of species: and in another part of the genus, one wide-spread American species figures under at least a dozen names.—Asa Gray, *in Silliman's American Journal*, Jan. 1858.

Description of a new Genus and some new species of American Birds. By P. L. Sclater, M.A., F.L.S. &c.

Neochloe, gen. nov.

Neochloe *genus novum* Vireoni *affine, sed ad* Sylvicolam *et hujusmodi genera spectans. Rostrum magis carinatum, basi latiore, apice magis acuta: alæ breves, quadratæ, remige prima brevi, secunda longiore, quarta, quinta, sexta et septima fere æqualibus et tertiam paulo superantibus; secundariis longis et primariam tertiam excedentibus: pedes ut in genere* Vireone.

Neochloe brevipennis.

N. cinereus, dorso murino et viridi paululum lavato: capite toto supero cum marginibus alarum et caudæ flavicanti-viridibus; remigibus et rectricibus intus nigricanti-cinereis: abdomine medio crissoque albis.

Long. tota 5·0, alæ 2·2, caudæ 2·1.

Of this little bird must, I think, be constituted a third genus of *Vireoninæ*; the peculiar form of the wing rendering it impossible to arrange it as either a *Vireo* or *Vireosylvia*. It has much of the general form of a small species of the former genus, but is readily separable by the short and square wing, all the secondaries (except the three outer) exceeding the second primary in length.

M. Botteri's collection contains one example of this bird (numbered 277), which is labelled "Orizaba, 8 Oct. 1856."

Zonotrichia botterii.

Supra ex cinereo rufescens, capitis et dorsi medii pennis medialiter fusco-nigris, harum autem marginibus rufescentibus, colore rufescente fusco mixtis: alis nigricantibus, tectricibus omnibus pallido fusco late, remigibus rufo anguste, extus limbatis: cauda graduata, nigricante; rectricum externarum apicibus valde dilutioribus, pallide cinereis: subtus albidus, pectore cinerascentiore, gula clariore, præcipue ad latera rufescente irroratus: carpo flavicante: alis et cauda subtus cinereis: rostro plumbeo; tomiis pallidioribus: pedibus flavis.

Long. tota 6·0, alæ 2·5, caudæ 2·6.

I have in vain attempted to identify this bird with any of the known species of N. American *Zonotrichiæ*, and am forced to the conclusion that it is probably undescribed. It comes nearer to *Z.*

Cassinii, Woodhouse (Proc. Ac. Sc. Philad. vi. p. 60), than to any other species with which I am acquainted; but differs from this entirely in the markings of the upper surface, the whole centre of the feathers being dark, whereas in *Z. Cassinii* the dark colour is confined to a subapical spot. The structure of the two birds is very much alike, but the feet are rather stronger in the present species. I hope M. Botteri will forward better specimens of this interesting species (the examples in the present collection being badly preserved), so as to allow me to make a more accurate investigation of its differential characters.

Diplopterus excellens.

Similis D. nævio *ex Amer. Merid. sed major, supra magis rufescens, caudæ tectricibus superioribus cinnamomescenti-rufis nigro longitudinaliter striatis: subtus purius albus, pectore non cinerascente, sed paululum rufo tincto: crisso rufescente: rostro breviore, altiore; tarsis longioribus.*

Long. tota 11·7, alæ 4·5, caudæ 6·3, tarsi 1·4.

M. Jules Verreaux, whose experienced eye is ever active in distinguishing new species, called my attention to this bird of M. Sallé's last collection, after I had somewhat doubtfully referred it to *D. nævius*. Upon a close re-examination it certainly appears distinct from the South American species, and I have set forth above the grounds of difference, though I have some doubts whether the prevailing rufous tinge of the back may not be owing to the bird being not quite adult. I have not adopted the term *mexicanus*, which M. Verreaux has used for this species in his MS. as we have already a *Dromococcyx mexicanus*, which is of a genus not separated by many authors from *Diplopterus*.—*Proc. Zool. Soc.* 1857.

On a quantity of Crabs thrown up on the Beach in Payta Bay. By Dr. C. Forbes, R.N.

For some time previous to the occurrence of a severe earthquake-shock, on or about the 30th August 1857, the Bay of Payta swarmed with crabs, of a kind not generally observed, and ten days after the earthquake they were thrown up on the beach, in a raised wall-like line, 3 to 4 feet wide, and to the height of about 3 feet, along the whole extent of the bay, and above highwater-mark.

At the same time that the upheaval of the crabs took place, the water of the bay became changed, from a clear blue, to a dirty blackish-green colour, much resembling that off the Island of Chiloe, Concepcion, and the southern parts of Chili. Ten days afterwards, Dr. C. Forbes found that living specimens of the crabs were still numerous in the bay, but all appeared to be sickly, and numbers came ashore to die.

There were no appearances of any alteration of the relative position of sea and land in the vicinity, nor had any ebullition of gases been observed; although probably to both these causes combined the phænomenon described was due.—*Proc. Geol. Soc.* Jan. 6, 1858.

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[THIRD SERIES.]

No. 4. APRIL 1858.

XXI.—*Notes on the Palæozoic Bivalved Entomostraca.* No. IV. *Some North American Species.* By T. Rupert Jones, F.G.S.

[With two Plates.]

[Continued from 2nd Series, vol. xvii. p. 101.]

The Entomostraca which I propose to describe in this communication have been brought from different parts of North America at different times, and kindly submitted to me for examination. The series of specimens from Canada were placed in my hands, in 1851, by Sir W. E. Logan; and I intended to describe them at once, but found that, without a more definite knowledge of the *Beyrichiæ* and allied forms already noticed by geologists, I could not do justice to the work. The Notes I., II., & III., on Palæozoic Bivalved Entomostraca, published in former volumes of the 'Annals,' have been the result of my inquiries on this subject; and at last I felt more capable of handling the series set before me. In the meantime, other North American materials came to hand. A portion of these specimens have taken their place as illustrative of generic characters in the former papers; and a portion remain to be noticed here, including the smaller Entomostraca in the limestone of Beechey Island, a few specimens from the United States in the Geological Society's Museum, and, more especially, a valuable series of beautiful specimens from Pennsylvania, which Prof. H. D. Rogers has most considerately and kindly permitted me to describe as illustrative fossils of the Geological Survey of that State.

Several species of bivalved Entomostraca have been already

noticed by the geologists of the United States; and some of these I believe I have satisfactorily recognized in specimens at my command; about some of the others I am still in much doubt; and some I have not as yet seen.

I proceed to describe the species: first, those from Beechey Island; 2ndly, those from Canada; 3rdly, those from the United States.

(*From Beechey Island.*)

1. *Beyrichia rugulifera,* spec. nov. Pl. IX. fig. 4.

Length $\frac{1}{20}$, breadth $\frac{1}{40}$ inch.

A "simple" or unisulcate *Beyrichia*; nearly oblong, narrow; extremities nearly equal; ventral margin faintly convex; dorsal notch broad and deep. Surface of valves ornamented with a delicate sculpturing of irregular, interrupted, somewhat sinuous, tapering, little grooves, arranged vertically (transverse to the long axis of the valve), appearing like a system of minute wrinkles.

From Beechey Island, in the limestone containing *Leperditia gibbera.* (See Annals Nat. Hist.* 2nd ser. vol. xvii. p. 91.)

2. *Beyrichia sigillata,* spec. nov. Pl. IX. fig. 5.

Length $\frac{1}{20}$, breadth $\frac{1}{32}$ inch.

Unisulcate, ovato-oblong, ends and belly well rounded, and margined by a broad, uniform, depressed rim; dorsal notch distinct, narrow. Surface of valves marked with numerous distinct, irregularly oval pits.

Beechey Island, with the foregoing.

3. *Beyrichia clathrata,* spec. nov. Pl. IX. fig. 1.

Length $\frac{1}{16}$, breadth $\frac{1}{26}$ inch.

A bisulcate form; the surface of the valve presenting a large horseshoe-shaped lobe, and a small, rounded, subcentral lobe; the latter being limited and almost surrounded by the two dorsal notches. Anterior portion of the valve somewhat puckered vertically,—a feature which is carried to an extreme in the next species, *B. plagosa.* Surface of the valves ornamented by a bold pattern of broad, shallow, subangular pits, having a somewhat radiate arrangement as regards the centre of the valve.

From Beechey Island, with the foregoing.

* I omitted to mention that the right valve figured in Pl. 7. fig. 8, was brought from Beechey Island by Dr. Armstrong, among other fossils.

This species much resembles some varieties of *B. Klœdeni* (Annals Nat. Hist. 2 ser. vol. xvi. p. 166), in which the fore and hind lobes are continuous, or nearly so, along the ventral part of the valve. In *B. clathrata*, however, and in *B. plagosa**, there is no interruption of the ventral lobe at all, which has a great relative breadth, like that in *B. Wilckensiana*, the type of the "Corrugatæ," or bisulcate group of *Beyrichiæ* (Annals Nat. Hist. 2 ser. vol. xvi. p. 85).

In *B. Klœdeni*, as in *B. tuberculata*, the ornamentation takes a granulate form; in the *Beyrichiæ* from Beechey Island, on the contrary, it is in intaglio.

4. *Beyrichia plagosa*, spec. nov. Pl. IX. fig. 2.

Length $\frac{1}{16}$, breadth $\frac{1}{26}$ inch.

This belongs also to the bisulcate type, and has a large semicircular, and a small, oval, subcentral lobe; but the former is traversed along its length by several more or less parallel and concentric, but irregular, sunken lines, dividing the lobe into about four large and six small convex stripes, of unequal proportions.

The whole surface is impressed by a system of minute channels, coarsely reticulate.

From Beechey Island, with the foregoing.

The *Beyrichiæ* from Beechey Island occur in considerable numbers, in company with *Leperditia gibbera* (Annals Nat. Hist. 2 ser. vol. xvii. p. 90), in a small piece of dark-coloured limestone brought to England by Capt. Sir E. Belcher. Like the *L. gibbera*, all the *Beyrichiæ* in this rock retain their shells, which exhibit a glossy surface and a brown colour.

For a *Cytheropsis* from Beechey Island, see p. 254.

* These two species were referred to, as being probably two varieties of *B. Klœdeni*, in Annals Nat. Hist. 2 ser. vol. vi. p. 91, but a careful examination has led me to regard them as certainly distinct from that species. With respect to their difference one from another,—although they have much in common as to their outline and general form,—though the ornament of *B. clathrata* may be the rudimentary state of the reticulation of *B. plagosa*, and though the plaiting of the latter is, as it were, begun in the anterior lobe of *B. clathrata*, yet, in accordance with the plan which we must adopt with fossil remains in which evidences of the soft parts are wanting, and which we are desirous of rendering useful palæontological witnesses of former races, I have given full weight to the differences of structure, and regarded these two *Beyrichiæ* as species and not varieties.

(*From Canada.*)

1. *Beyrichia Logani**, spec. nov. Pl. IX. figs. 6–10.

Length $\frac{1}{16}$, breadth $\frac{1}{26}$ inch.

This is a small *Beyrichia* of the unisulcate group ("Simplices," Annals Nat. Hist. 2 ser. vol. xvi. p. 85); variable in shape, from reniform to oblong; dorsal edge straight, extremities rounded and almost equal; ventral edge varying in its convexity. Surface of the valves somewhat depressed, most convex a little above the median line, sloping more gently to the ventral than to the dorsal margin; usually punctate, sometimes smooth; always bearing a distinct narrow depression on the dorsal region, usually on its anterior third; this dorsal notch reaches across a third or even more of the breadth of each valve. Ventral and terminal margins bordered by a narrow depressed rim.

I cannot regard the extreme shapes of the gregarious and innumerable individuals of this *Beyrichia* as typical of specific distinction. The general form, the relative convexity, and the dorsal notch are the more characteristic features.

a. Var. *reniformis*. The extreme of the kidney-shaped form is well shown in fig. 6, a specimen from Hawkesbury, occurring with others like it, with many of oblong outline, and some of intermediate shapes. The specimen here figured is strongly punctate: smooth specimens of this variety occur at Grenville.

b. Var. *leperditioides*. In fig. 10 we have one of the specimens in which the antero- and postero-dorsal corners of the valves become modified towards the well-marked oblique dorsal angles of *Leperditia*†.

Localities. Grenville and Hawkesbury; in the "two-foot limestone," in the upper part of the Calciferous Sandrock (see further on, p. 245).

2. *Leperditia Canadensis*‡, spec. nov. Pl. IX. figs. 11–15.

Length $\frac{1}{9}$, breadth $\frac{1}{13}$ inch.

Small; somewhat variable in shape, but always retaining the characteristic Leperditia-outline, with straight back, more or less obliquely-rounded belly, and sloping dorsal angles. Carapace usually short (the height or breadth being about two-thirds of the length), somewhat variable in the amount of convexity

* Referred to in Quart. Journ. Geol. Soc. vol. viii. p. 207.

† See p. 247 for further remarks on *B. Logani* and its varieties, in relation to *L. Canadensis*.

‡ Referred to in Quart. Journ. Geol. Soc. vol. viii. p. 202 & p. 207.

(thickness), which is usually greatest at the antero-ventral third. Surface smooth. Eye-tubercle generally well marked, and muscle-spot often distinct; but occasionally the latter becomes involved in the nuchal depression, and the former is sometimes obsolete.

This is the smallest form of *Leperditia* which I have yet met with. It occurs in great numbers, together with *Beyrichia Logani* in equal abundance, in a dark-grey friable limestone, mainly composed of these Entomostraca, fragments of Trilobites, and shells, at Grenville and near Hamiltonville in Hawkesbury, on the Ottawa. This Leperditia-limestone forms part of a band of limestone, about 2 feet thick, which extends over a wide district*, and is of importance as marking the position of a continuous band of concretionary phosphatic rock which is beneath it, and belongs either to the base of the Chazy limestone†, or the summit of the Calciferous Sandrock‡.

L. Canadensis occurs also in a dark-grey, crystalline, shelly limestone (of the Calciferous Sandrock) at Grande Isle § (north side), in the St. Lawrence. In two hand-specimens of this limestone a few separate valves and one pair of valves are present.

a. Var. *labrosa.* Pl. IX. fig. 13.

Length $\frac{1}{6}$, breadth $\frac{1}{10}$ inch.

The extremities of the valves are in this specimen from Hawkesbury marked by a broad marginal depression, which is continued less strongly along the ventral border; and the antero-dorsal corner is more produced than usual.

This may be an individual modified by accidental circumstances of growth.

b. (*Leperditia Canadensis*? Pl. IX. figs. 16, 17.)

Specimens of possibly the same species as the foregoing, but of a considerably larger size (often twice as large), occur in two other limestones, specimens of which Sir W. Logan has confided to my care.

Imbedded in bits of black fine-grained limestone from Louck's

* "This rock, having been quarried for lime-burning in several places, has been followed from Carillon to Grenville (thirteen miles)." Quart. Journ. Geol. Soc. vol. viii. p. 207; and Logan's Report Geol. Surv. Canada, 1851–52, p. 18.

† The *Atrypa plena*, which is characteristic of the base of the Chazy limestone, appears to occur above the Leperditia-bed.

‡ Esquisse géologique du Canada, par W. E. Logan et T. S. Hunt, p. 42.

§ Quart. Journ. Geol. Soc. vol. viii. p. 202; and Logan's Report, 1851–52, p. 15.

Mill, on the Castor River (Russell Township), are three glossy black valves, in good preservation, and of different sizes (one specimen being $\frac{3}{10}$ in. long and $\frac{2}{10}$ broad; the others being respectively $\frac{3}{20}$ in. and $\frac{3}{40}$ in. in length). In each of these the eye-spot is very distinct, and accompanied by a local ruggedness of the surface of the valve (not amounting to a sulcus), and the valves are faintly rimmed.

This black limestone is referred to the "Trenton" in 'Geol. Surv. Canada Report,' 1851–52, p. 73; but, according to a letter of later date from Sir W. E. Logan, it may be "Birdseye limestone."

A small specimen of brownish, fine-grained limestone (weathering grey, and containing shells), from Pauquette's Rapids, Allumette Island, Ottawa River, contains one well-preserved brown-coloured valve (fig. 17), $\frac{1}{4}$ inch long, $\frac{3}{20}$ inch broad, much like the largest specimen from Louck's Mill, but showing no marginal rim, and feeble traces only of the eye-spot and its accompanying depression. In this fragment of (probably Trenton) limestone smaller Entomostracous bivalves abound (see p. 249).

Excepting in the relative size, the form of the eye-spot, and the valve-margin (in which latter points one of these larger specimens varies from the others), the two sets of specimens (the large and the small) do not appear to disagree essentially, as far as my means of examination at present enable me to judge. At the same time, as we know that, in some recent bivalved Entomostraca, different species and even subgenera may present a great similarity in their carapaces, it is possible that we have here a separate specific form.

Mr. Conrad has briefly described*, under the name of "*Cytherina fabulites*," a bivalved Entomostracan, from the Trenton limestone of Mineral Point, Wisconsin. This appears to be a *Leperditia* half an inch in length, and therefore surpassing in size the specimens under notice, to which it may be allied.

Other localities in Canada are mentioned by Sir W. E. Logan and Mr. Murray for Entomostraca—probably *L. Canadensis* or allied forms: namely:—

Three miles above Lachine; in the Trenton limestone?†.

Indian Lorette near Quebec; in the Birdseye limestone? ‡.

"Three or four miles from Montreal city, in a line a little west of north; in Birdseye limestone §."

* Proceed. Philad. Acad. vol. i. p. 332.

† Quart. Journ. Geol. Soc. vol. viii. p. 205.

‡ Letter, Jan. 17, 1853. § Letter.

Sheik's Island, Cornwall, on the St. Lawrence*; with *Atrypa plena* (Chazy).

Cornwall; in the Trenton limestone†.

Lancaster; in the Black River limestone‡.

Winchester; in the Trenton limestone§.

Beyrichia Logani and *Leperditia Canadensis* occur together in immense numbers, forming indeed a considerable portion of the rock—a limestone, 1 foot 10 inches thick—in which they are chiefly found. I believe that the former is not the young of the latter (although, perhaps, the differences of shape and structure are not greater than such as we find to occur between the young and adult forms of recent Entomostraca and other Crustacea), because, where the allied *Beyrichiæ*, such as *B. strangulata* ||, *B. mundula*, and *B. simplex*, occur, even in equal numbers, in the rocks of other localities, the *Leperditiæ* are not found with them; the latter also occurring unaccompanied by these *Beyrichiæ*; and *L. Canadensis* itself being found isolated in Grande Isle. The close resemblance in outline of some specimens of *B. Logani* (var. *B. leperditioides*, fig. 10) to the *Leperditiæ* is, I believe, merely a mimetic resemblance of outline, such as we find taking place among many groups, both of the lower and the higher animals.

3. *Leperditia Anna*¶, spec. nov. Pl. IX. fig. 18.

Length $\frac{1}{6}$, breadth $\frac{1}{9}$ inch.

Small, convex; ovate-oblong, somewhat narrower in front than behind; the ventral curve nearly uniform; hinge-line straight; dorsal angles slightly truncate. Surface of valves most convex at the posterior third; smooth, thickly punctate, each of the little shallow circular pits having a minute central tubercle. Eye-spot distinct and raised.

Several valves of this neatly-pitted *Leperditia* are present in a small hand-specimen of a hard, dark-coloured, concretionary limestone, under the zone of *Atrypa plena*, and belonging to the Calciferous Sandrock, from "immediately behind the village of St. Ann's**," at the confluence of the Ottawa and St. Lawrence. This is probably the oldest known species of the genus.

* Geol. Surv. Canada Report, 1851–52, p. 70. † *Ibid.*

‡ *Ibid.* p. 71. § *Ibid.* p. 72.

|| *Beyrichia strangulata* takes on a variety of forms (see Annals Nat. Hist. vol. xvi. pl. 6. figs. 18–22) analogous to those of *B. Logani.*

¶ Referred to in Quart. Journ. Geol. Soc. vol. viii. p. 204.

** Quart. Journ. Geol. Soc. *loc. cit.*; and Geol. Surv. Canada, Report, 1851–52, p. 16.

ISOCHILINA*. Subgenus of *Leperditia*.

Equivalve; the margins of the valves meeting uniformly, not overlapping as in *Leperditia*; greatest convexity of the valves either central or towards the anterior portion. Eye-tubercle present. Muscular spot not distinct externally.

4. *Leperditia* (*Isochilina*) *Ottawa*, spec. nov. Pl. X. fig. 1.

Length $\frac{1}{6}$, breadth $\frac{1}{10}$ inch.

Leperditia-like in outline, somewhat elongate, smooth; marginal border distinct, frequently seen to be marked by a line of small, distinct pits; eye-spot distinctly raised.

From the Canal, Grenville. Gregarious; the separated valves forming a thin seam, about half an inch thick, in a dark-grey limestone in the Calciferous Sandrock, a foot or two beneath the "two-foot limestone," and traceable for some miles.

5. *Leperditia* (*Isochilina*) *gracilis* †, spec. nov. Pl. X. fig. 2.

Length $\frac{1}{7}$, breadth $\frac{1}{12}$ inch.

Carapace subrhomboidal, narrow and slender compared with the *Leperditiæ* proper; anterior extremity obliquely rounded, with the antero-dorsal angle produced, slightly obtuse; posterior extremity rounded, with the postero-dorsal angle obliquely truncate. Ventral curve uniform. Surface of valve convex centrally, black, shining, smooth, sparsely punctate; the pitting partial, often obscure, or nearly obsolete. Depressed margin broad, in many specimens bearing a row of rounded pits (about 32), which are represented on the inside of the rim by corresponding raised obtuse points.

Gregarious, in loose fragments of a black, fine-grained, fœtid limestone, from the White Horse Rapids (Isle Jesus), referred, with doubt, to the Trenton limestone in the Quart. Journ. Geol. Soc. vol. viii. p. 205, but to the Birdseye limestone in a letter of later date from Sir W. E. Logan. The disunited valves lie matted together, and sprinkled with minute iridescent crystals of pyrites, in a thin layer, or layers, in the rock.

CYTHEROPSIS, genus, M'Coy.

This generic appellation is affixed to a bivalved Entomostracan (fig. 2. pl. 1 L) in the 'Systematic Description of the British Palæozoic Fossils in the Geological Museum of the University of Cambridge,' 1855, but neither the characters of the genus

* *Equal-lip*: ἴσος, equal; χεῖλος, lip.

† Referred to in Quart. Journ. Geol. Soc. vol. viii. p. 205.

nor of the fossil are described, owing probably to the author not having had time to add this description to the great work referred to.

Cytheropsis appears to me to be a useful term for the distinction of those palæozoic Entomostraca that do not closely assimilate either to *Leperditia* or *Beyrichia*, but much resemble in outline and size many of the *Cytheres* of the existing seas, differing however from them in sometimes having eye- or muscle-spots, and other peculiar features, such as a comparatively great thickness of the valves. Though based chiefly on negative characters, yet this group may for the present be conveniently referred to as being generic.

I have noticed several minute Entomostraca in the Silurian rocks of Wales and Sweden, which may probably belong to this group.

6. *Cytheropsis concinna*, spec. nov. Pl. X. figs. 3, 4.

Length $\frac{1}{17}$, breadth $\frac{1}{33}$ inch.

Carapace subcylindrical, tapering anteriorly; ends rounded; back straight; dorsal angles slightly truncate; ventral edge of right valve overlapping that of the left. Surface smooth, shining, light-brown, partially pitted. In some specimens a very slight marginal rim is traceable.

Many specimens, both of double and single valves, in the Trenton (?) limestone of Pauquette's Rapids, Allumette Island, Ottawa River.

I have had some doubt whether this may not be the young of a *Leperditia*; but it has no eye-spot and is too narrow, young *Leperditiæ* being proportionally broader than the adults.

7. *Cytheropsis Siliqua*, spec. nov. Pl. X. fig. 6.

Length $\frac{1}{12}$, breadth $\frac{1}{40}$ inch.

Carapace-valves long, narrow, pod-like or skiff-shaped; ends acute, one much sharper and more tapering than the other; dorsal edge long and straight; ventral edge convex; one valve overlapping the other. Smooth, shining, brown.

Two separate valves of this curious and rather obscure form (so much resembling *Bairdia Siliqua* of the Chalk, and the recent *B. Minna*) occurred in the limestone from Pauquette's Rapids.

8. *Cytheropsis rugosa*, spec. nov. Pl. X. fig. 5.

Length $\frac{1}{30}$, breadth $\frac{1}{46}$ inch.

Small, convex, subreniform, broad, rounded at both ends,

one of which (anterior) is smaller than the other. Coarsely sculptured with broad shallow pits. One specimen, showing the two valves united, and of a light-brown colour, occurred with the many other Entomostraca in the small specimen of limestone from Pauquette's Rapids.

(*From the United States.*)

1. *Leperditia alta*, Conrad, sp. Pl. X. figs. 10, 11.

Annals Nat. Hist. 2 ser. vol. xvii. p. 88. pl. 7. figs. 6 & 7.

Numerous individuals of this species occur in the dark-coloured "Tentaculite-limestone"* of Schoharie, accompanied by *Spirifer plicatus*. The specimens are mostly in an indifferent state of preservation; but here and there evidences of the smooth surface of the valves are obtained. In outline most of them resemble fig. 7*a* of Pl. 7 above referred to; but others are more tapering anteriorly, as in the figures now given (Pl. X. figs. 10 & 11).

I have now no doubt that the Arctic specimens before described belong to this species.

The "Tentaculite-limestone" of Schoharie belongs to the Lower Helderberg group of strata,—the "Premeridian" group of the classification adopted by the Professors Rogers.

2. *Leperditia gibbera*, Jones, Annals Nat. Hist. 2 ser. vol. xvii. p. 90. pl. 7. figs. 8–10.

Var. *scalaris*. Pl. X. figs. 7–9.

In the grey "Waterlime-rock" of Williamsville, specimens of which, collected by Sir C. Lyell, are now in the Geological Society's Museum, are some casts of a fine *Leperditia* (one specimen being $\frac{1}{2}$ inch long and $\frac{3}{10}$ inch broad, with others smaller and of different sizes) which has the general aspect of *L. gibbera* of the Silurian limestone of Beechey Island, but is larger and less convex, and has a much smaller hump on the dorsal region of the left valve.

In the black limestone (weathering grey) of the "Scalent group" (Rogers),—of about the same age as the "Waterlime" of Williamsville,—there also occur specimens of a similar form. These are in a beautiful state of preservation, exhibiting glossy black valves. The left valve bears a distinct, but small, dorsal

* In the collection of Silurian fossils brought by Sir C. Lyell from North America, and now in the Museum of the Geological Society of London, are several specimens of this Leperditia-limestone.

hump; the right valve is without it; and the surface of both is smooth and unornamented, except that the muscle-spot is seen under a lens to be neatly and faintly reticulated, but apparently unaccompanied with radiated vascular markings (figs. 8 & 9).

These specimens vary much in size. There is a fragment of an individual which was larger than even the largest of the specimens from the grey limestone of Williamsville. On the other hand, there is a single left valve only $\frac{1}{8}$ inch long,—probably of a young individual: this is broader in proportion to its length than the larger individuals, being ovate in outline, and presents no dorsal hump, which, from this, would appear to be acquired in the adult state only.

The differences between *L. gibbera* of the Arctic limestone and these specimens from the United States are—the absence of pittings on the surfaces of the latter, and the smallness of the dorsal hump of their left valve. There are also larger individuals among these more southern specimens; but, as the number of the Arctic specimens was very limited, the exact relative size cannot be regarded as fairly ascertained. From the above considerations, I regard the specimen under notice as belonging to a variety of *L. gibbera.*

A thin seam of hard grey limestone, half an inch thick, on a rather higher horizon than that of the black limestone just referred to, has its surfaces thickly beset with badly preserved valves of a *Leperditia,* apparently of the same variety as the last-described.

3. *Leperditia Pennsylvanica,* spec. nov. Pl. X. figs. 12, 13.

Length $\frac{6}{10}$, breadth $\frac{7}{20}$ inch.

Valves very convex, mostly at the middle and somewhat anteriorly; the posterior half of the valve sloping more gradually, and broader, than the anterior, and rounded; dorsal margin straight and long.

This species is very near to *L. Balthica** of Europe and *L. Arctica*† of North America; but it is narrower and more convex; its eye-spot, which is very distinct, and placed on an angular escutcheon (as in *L. Arctica*), is rather nearer to the dorsal edge, and is accompanied by greater local unevenness of the surface, than in either *L. Balthica* or *L. Arctica*; and the substance of the valves is thinner than in these species.

A specimen of greyish limestone from near Barre Forge,

* Annals Nat. Hist. 2 ser. vol. xvii. pl. 6. figs. 1–5.
† *Ibid.* pl. 7. figs. 1–5.

Pennsylvania, belonging to the "Surgent group," and of the same age as the "Clinton group*," is full of individuals of this species. It exhibits numerous light-brown valves, of different sizes, and in good preservation, showing smooth, non-punctate surfaces, with the eye-spot and its escutcheon, and the muscle-spot with its reticulated surface and delicate sinuous radii passing downwards and backwards (fig. 12). *L. Pennsylvanica* is here accompanied by a few specimens of a minute *Beyrichia* (*B. Pennsylvanica* ?).

In some fragments of another greyish limestone of the "Surgent group," we have numerous specimens, some well preserved, of this species; the valves are of a darker tint than in other instances, and somewhat more convex (fig. 13).

4. *Leperditia ovata*, spec. nov. Pl. X. fig. 14.

Length $\frac{3}{10}$, breadth $\frac{2}{10}$ inch.

In a specimen of the Blackriver-limestone ("Auroral group") of Potter's Fort, Penn's Valley, Pennsylvania,—a bluish-grey crystalline limestone, containing Spirifers and Encrinites,—occurs a single right valve of a small *Leperditia*, black, smooth, unornamented, having a nearly ovate outline and a convexity sufficient to give a subglobose form to the closed carapace. The slightly raised muscle-spot marks the centre of the valve; but the eye-spot is wanting.

The want of angularity in this form, though it has a straight hinge-line, its central muscle-spot, and absence of ocular tubercle distinguish it from *L. Canadensis*, and offer sufficient characteristics to lead me to recognize it by the specific name of *L. ovata*.

The *Cytherina fabulites* of Mr. Conrad† appears, from the brief description given of it, to be somewhat allied to the species before us. Mr. Conrad's specimen is from the Trenton limestone of Mineral Point, Wisconsin.

5. *Beyrichia Maccoyiana*, Jones. Pl. X. fig. 15.

Annals Nat. Hist. 2 ser. vol. xvi. p. 97. pl. 5. fig. 14.

Numerous individual valves of this species, of a somewhat larger size than the Scandinavian specimens, and in fine preservation, occur in a flaky calcareous rock, almost wholly com-

* For the classification of the Palæozoic Rocks of North America, see Prof. H. D. Rogers's Geological Map of the United States, in Keith Johnston's 'Physical Atlas;' also Prof. James Hall's works on the Geology and Palæontology of the State of New York.

† Philad. Acad. Nat. Sc. Proceed. vol. i. p. 332.

posed of *Beyrichiæ* (*B. Pennsylvanica*), from the limestone-bands of the marls of the Scalent series of Pennsylvania.

6. *Beyrichia Pennsylvanica*, spec. nov. Pl. X. figs. 16–18.

Length $\frac{1}{24}$, breadth $\frac{1}{40}$ inch.

Carapace-valves small, varying from oblong to nearly reniform, convex, coarsely punctate or reticulate, and marked by two short dorsal notches, which are variable in their development. Sometimes the anterior notch is obsolete (see fig. 16),—probably a condition of the young state,—giving the valve a unisulcate appearance. Sometimes the two notches encircle a small roundish lobe (fig. 17); but usually they are distinct, and separated by the central lobe of the valve's surface (fig. 18). Many conditions intermediate to these occur.

In its one-notched state, this species much resembles *B. strangulata*, and in its fully-developed trilobed form it resembles some varieties of *B. Klœdeni*, on the one hand, and *B. clathrata* of Beechey Island, on the other: but it is certainly distinct from either.

Innumerable individuals of this *Beyrichia*, of different stages of growth, are present in the limestone-bands in the marls of the Scalent group of Pennsylvania (Onondaga Salt group). Some of this hard calcareous rock, which is dark-grey internally, but weathers of a lighter and ferruginous grey, is almost composed of the *Beyrichiæ*, and is traversed by very fine parallel linear fissures, occupied by calc-spar.

The same species occurs in equal numbers, in company with *B. Maccoyiana*, in a somewhat similar rock of the same formation, but softer, more flaky, and not traversed by cleavage-lines.

I have found two individuals of apparently a smooth variety of this species, showing the three lobes, as in fig. 18, in the greyish limestone from near Barre Forge, where it is associated with *Leperditia Pennsylvanica*.

7. *Leperditia* (*Isochilina*) *cylindrica* (?), Hall, Palæontology of New York, vol. ii. p. 14. pl. 4. fig. 8.

Under the name of "*Cytherina cylindrica*," Prof. James Hall has noticed and figured some Entomostraca in the "Medina Sandstone" of Orleans County; and though these figures and description are of little service in the identification of the species, yet, having examined some apparently similar specimens also in Medina sandstone, I offer some remarks on the subject, espe-

cially as it appears to me that we have here an interesting zoological link between the faunæ of different regions.

A specimen of "Medina Sandstone," containing *Lingula cuneata*, from Rochester Creek, Niagara, in the Geological Society's Museum, contains several coarse sandy casts of a *Leperditia* (subgenus *Isochilina*), occasionally $\frac{1}{4}$ inch long and $\frac{3}{20}$ inch broad, resembling the specimens from Russia figured in Annals Nat. Hist. 2 ser. vol. xvii. pl. 7. figs. 11 & 12, which were referred with considerable doubt* to *L. marginata* of Keyserling, and are most probably of the same species as those figured by Eichwald† under the name of "*Cypridina Balthica*."

It is easy to find on the piece of sandstone before me imperfect or partially imbedded specimens more or less resembling the figures given by Prof. Hall; and, should they prove to be the same as his, I shall be inclined to apply his name of "*cylindrica*" to "the smaller form of *L. marginata*‡"; and, as I have already suggested its independence of the large *L. marginata*, being itself probably an adult form, and that it would belong, in that case, to a subgenus of *Leperditia*, I feel little hesitation in grouping it with the *Isochilinæ* described above § (p. 248).

(*Beechey Island: additional.*)

5. *Cytheropsis concinna*? Pl. IX. fig. 3.

Length $\frac{1}{22}$, breadth $\frac{1}{37}$ inch.

Oblong-ovate, somewhat Leperditia-shaped; ends unequal, ventral edge well rounded; surface smooth.

This very much resembles *C. concinna* (above, p. 249).

Several specimens occur in the limestone from Beechey Island.

The following Table exhibits a general view of the genera and their species as yet known in Arctic America, Canada, and the States.

* *Op. cit.* p. 91. There is an important error to be corrected in the page here referred to: at line 7 from bottom *for* fig. 6 *read* figs. 7 & 8.

† Bullet. Imp. Soc. Moscou, 1854, no. 1. p. 99. pl. 2. figs. 7 & 8. "*C. Baltica*" and "*C. minuta*" are also quoted by Capt. P. Jeremejew, as occurring at Iswos, &c. Verhandl. R.-K. Min. Ges. 1856, p. 83.

‡ *Op. cit.* p. 94.

§ In connexion with the Russian specimens above alluded to, M. Eichwald mentions a form having a row of punctiform pits on the border of the valve (Annals, *loc. cit.* p. 93). This is an important feature also in the *Isochilinæ* above described from Canada (see p. 248).

	Localities.	Prof. Hall's groups.	Prof. Rogers's groups.	British groups.
1. Beyrichia rugulifera, *Jones*				
2. —— sigillata, *Jones*				
3. —— clathrata, *Jones*	Beechey Island			
4. —— plagosa, *Jones*				Wenlock group.
5. Leperditia gibbera, *Jones*		....	....	
6. —— Arctica, *Jones*	Wellington Straits			
7. —— marginata, *Keyserling*	Rupert's Land (and Petschora Land)	....	....	?
8. —— alta, *Conrad*	Schoharie (and Wellington Straits)	Coralline Limestone and Tentaculite Limestone (Lower Helderberg)	Premeridian	
5*a*. —— gibbera, var. scalaris	Williamsville and Pennsylvania	Waterlime		Wenlock group.
9. Beyrichia Maccoyiana, *Jones*	Pennsylvania	Onondaga Salt-group	Scalent	
10. —— Pennsylvanica, *Jones*	Pennsylvania			
11. Leperditia Pennsylvanica, *Jones*	Pennsylvania	Clinton group	Surgent	
12. Beyrichia lata, *Vanuxem*	Oneida County, &c.			Llandovery group.
13. Isochilina cylindrica (?), *Hall*	Medina, &c.	Medina Sandstone	Levant	
14. Leperditia fabulites, *Conrad*	Wisconsin	Trenton Limestone		
15. Cytheropsis concinna, *Jones*			Matinal	
16. —— Siliqua, *Jones*	Allumette Island, Ottawa	Trenton Limestone?		
17. —— rugosa, *Jones*				
20*a*. Leperditia Canadensis (large var.)				
18. —— ovata, *Jones*	Pennsylvania	Blackriver Limestone		Llandello and Caradoc groups.
20*a*. —— Canadensis (large var.)	Louck's Mill, Canada	Birdseye Limestone	Auroral	
19. Isochilina gracilis, *Jones*	Isle Jesus, Canada			
20. Leperditia Canadensis, *Jones*	Grande Isle, Grenville, and Hawkesbury			
21. Beyrichia Logani, *Jones*	Grenville and Hawkesbury	Calciferous Sandrock	Primal	
22. Isochilina Ottawa, *Jones*	Grenville, Canada			
23. Leperditia Anna, *Jones*	St Ann, Canada			

Two other forms of Entomostraca, with which I am as yet unacquainted, are described by Prof. J. Hall; namely "Cytherina spinosa," Pal. N. York, vol. ii. p. 317. pl. 67. f. 17–21, and "Beyrichia symmetrica," *loc. cit.* f. 16, from the Niagara Shale, Lockport. Hall also mentions and figures another form (*op. cit.* vol. i. p. 44. pl. 10. f. 12) from the Birdseye Limestone and Trenton Limestone.

EXPLANATION OF THE PLATES.

Plate IX.

[From Beechey Island. In the Museum of the Geological Survey of Great Britain.]

Fig. 1. *Beyrichia clathrata*; left valve: *a,* magnified 4 times; *b,* magnified 24 times.

Fig. 2. *B. plagosa*; left valve: *a,* magnified 4 times; *b,* magnified 24 times.

Fig. 3. *Cytheropsis concinna* (?); right valve: *a,* magnified 4 times; *b,* magnified 24 times.

Fig. 4. *B. rugulifera*; right valve: *a,* magnified 4 times; *b,* magnified 24 times; *c,* portion of surface of *b,* magnified 75 diameters.

Fig. 5. *B. sigillata*; left valve: *a,* magnified 4 times; *b,* magnified 24 times.

[From Canada. In the Museum of the Geological Survey of Canada.]

Fig. 6. *B. Logani* (var. *reniformis*); magnified 4 times: *a,* right valve; *b,* dorsal view; *c,* anterior view. From Hawkesbury.

Fig. 7. *B. Logani*; magnified 4 times: *a,* left valve; *b,* dorsal, and *c,* posterior view. From Hawkesbury.

Fig. 8. *B. Logani*; magnified 4 times: *a,* left valve; *b,* ventral, and *c,* posterior view. From Grenville.

Fig. 9. *B. Logani*; magnified 4 times: *a,* right valve; *b,* dorsal view. From Hawkesbury.

Fig. 10. *B. Logani* (var. *leperditioides*); magnified 4 times: *a,* right valve; *b,* anterior view. From Grenville.

Fig. 11. *Leperditia Canadensis*; magnified 4 times: *a,* left valve; *b,* ventral, and *c,* posterior view. From Grenville.

Fig. 12. *L. Canadensis*; magnified 4 times: *a,* right valve; *b,* ventral view. From Grenville.

Fig. 13. *L. Canadensis* (var. *labrosa*); magnified 4 times: *a,* left valve; *b,* ventral, and *c,* anterior view; *d,* portion of surface of *a,* very highly magnified (× 75).

Fig. 14. *L. Canadensis*; magnified 4 times: *a,* left valve; *b,* dorsal, and *c,* anterior view. From Grande Isle.

Fig. 15. *L. Canadensis*; dorsal view of the united valves (nearly closed); magnified 4 times. From Grande Isle.

Fig. 16. *L. Canadensis* (large variety): *a,* right valve, magnified 2 diameters; *b,* ventral view; *c,* anterior view; *d,* outline, magnified 4 times. From Louck's Mill.

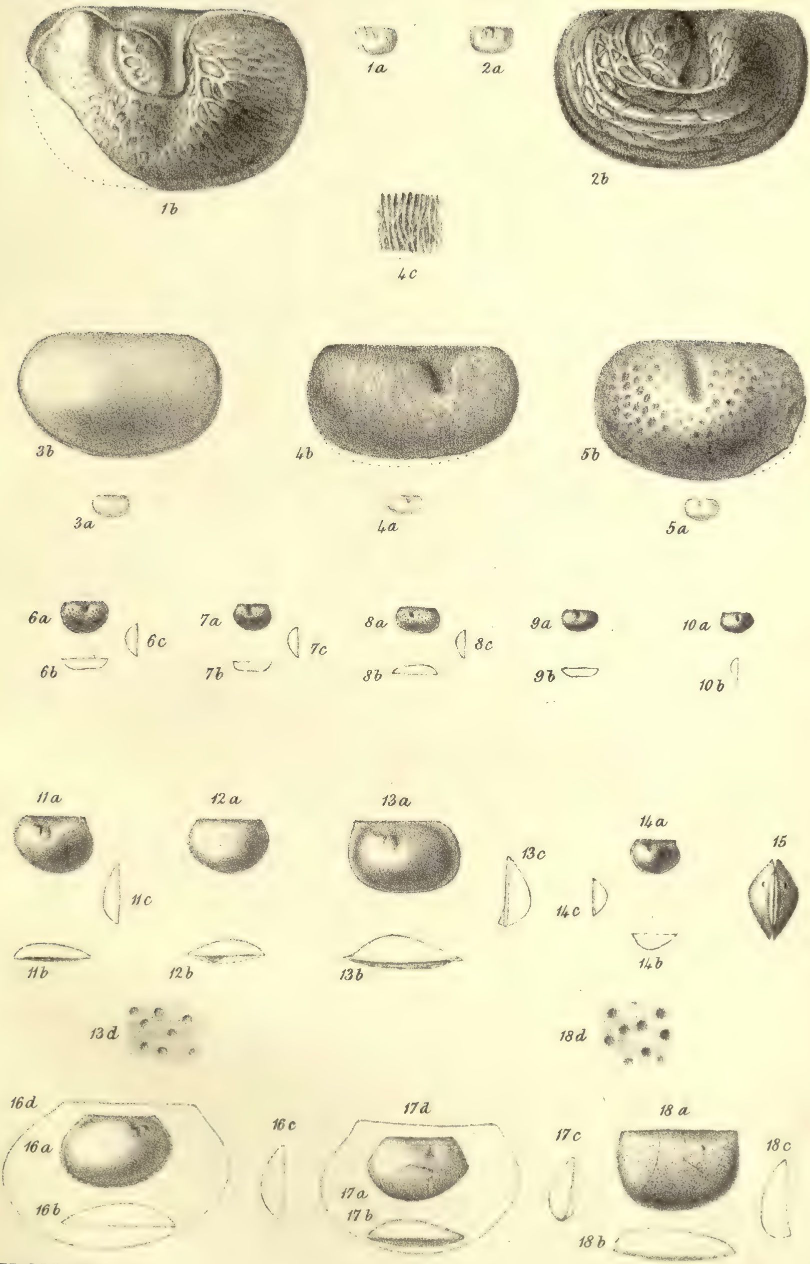
Fig. 17. *L. Canadensis* (large var.): *a,* right valve, magnified 2 diameters; *b,* the ventral, and *c,* the anterior view, showing the inner flange of the ventral edge; *d,* outline, magnified 4 times. From Pauquette's Rapids.

Fig. 18. *L. Anna*; magnified 4 times: *a,* right valve; *b,* ventral, and *c,* anterior view; *d,* portion of surface of *a,* highly magnified (× 25). From St. Anne's.

Plate X.

[In the Museum of the Geological Survey of Canada.]

Fig. 1. *Isochilina Ottawa*; magnified 4 times: *a,* left valve; *b,* anterior, and *c,* ventral view. From Grenville Canal.



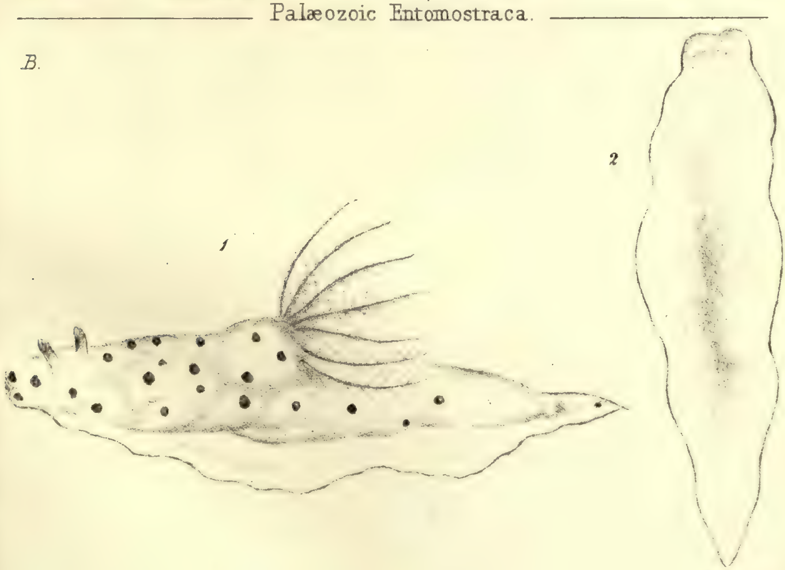
T.R.J. del. G.West lith.

W West imp.

Palæozoic Entomostraca.

Palæozoic Entomostraca.

B.



W. West imp

Trevelyana Ceylonica.

Fig. 2. *I. gracilis*; magnified 4 times: *a*, right valve; *b*, anterior view, and *c*, ventral; *d*, magnified portion of the marginal rim. From White Horse Rapids.

[From Pauquette's Rapids. In the Museum of the Geol. Survey of Canada.]

Fig. 3. *Cytheropsis concinna*; left valve; magnified 12 times.

Fig. 4. *C. concinna*; ventral aspect of the closed valves; magn. 12 times.

Fig. 5. *C. rugosa*; magnified 12 times: *a*, right valve; *b*, ventral aspect of the closed valves; *c*, portion of the surface, magnified 50 times.

Fig. 6. *C. Siliqua*; right valve; magnified 12 times.

Fig. 7. *Leperditia gibbera*, var. *scalaris*: *a*, internal cast of the left valve; *b*, ocular and muscular spots, magnified. From Williamsville. In the Museum of the Geological Society.

[From Pennsylvania.]

Fig. 8. *L. alta*: right valve, natural size.

Fig. 9. *L. alta*; internal cast of left valve; natural size.

[From Schoharie. In the Museum of the Geological Society.]

Fig. 10 *a*. *L. gibbera*, var. *scalaris*; left valve; natural size; *b*, ocular and muscular spots, magnified.

Fig. 11. *L. gibbera*, var. *scalaris*; right valve; natural size.

[From Pennsylvania.]

Fig. 12. *L. Pennsylvanica*: *a*, right valve, natural size; *b*, ocular and muscular spots, magnified.

Fig. 13. *L. Pennsylvanica*; left valve; natural size.

Fig. 14. *L. ovata*; right valve; natural size.

Fig. 15. *B. Maccoyiana*: *a*, left valve, magnified 4 times; *b*, portion of surface, highly magnified.

Fig. 16. *B. Pennsylvanica*, right valve; magnified 4 times.

Figs. 17, 18 *a*. *B. Pennsylvanica*, left valves; magnified 4 times.

Fig. 18 *b*. *B. Pennsylvanica*; portion of the surface, highly magnified.

XXII.—*Description of a new Ceylonese Nudibranch.* By Dr. E. F. Kelaart.

[With a Plate.]

Doridæ.

Trevelyana, new genus.

Body without a cloak. Two dorsal tentacles, without sheaths; non-retractile. Mouth in front of head, without tentacles. Branchiæ in a circular disk on the back, non-retractile.

Trevelyana Ceylonica. (Pl. X. B.)

Body 1¾ inch long, narrow, elevated and inflated near the branchial plumes; semigelatinous, white, and spotted with small

dark orange-red spots, set wide apart from each other. Head rather produced and rounded, also spotted with red. Mouth circular, small, situated in front, without veil or tentacles. Branchial plumes 15 or 16, situated on the posterior third of the back, round a large disk, in the centre of which is the vent. Plumes long, downy, closely set, pure white, with a longitudinal bright-red streak on the back of each; slightly contractile, but they do not retract into a cavity; when extended, they resemble a small tuft of marabout feathers. Genital orifice in a nipple-like process situated between the anterior and middle third of body.

Foot long and broad, terminating posteriorly in a lancet-shaped point, about ¼ inch from the body; white, with a delicate light orange-red line on the edge; this line is carried partially on each side of the head. Tentacles 2, dorsal, short, conical, pointed; upper half indistinctly laminated; of a light orange-red colour at tip; base colourless, transparent.

Found on rocks and sea-weed, near 'Sober Island.'

This elegant creature does not resemble any of the described species.

I have ventured to make a distinct genus of this animal, and dedicate it to Sir Walter Trevelyan, to whom I am so much indebted for the liberal aid he has given me in my researches into the natural history of Ceylon.

The form of the body is not unlike that of the genus *Ancula*. Its nearest approach in other particulars is to *Polycera*.

They are short-lived in a vivarium. Ova *yellow*, deposited in bead-like coils. They generally deposit the coils on twigs of sea-weed. Sometimes this animal resembles a miniature fantail pigeon, particularly when perched on sea-weed, with the small marabout plumes elongated.

XXIII.—*Note on the Red Colouring Matter of the Sea round the Shores of the Island of Bombay.* By H. J. Carter, Esq., H.C.S. Bombay*.

From "the plagues of Egypt" down to the present day, the blood-red colour which occasionally makes its appearance in fresh and salt water has been an object of wonder. Numbers of instances of it are recorded by navigators of all ages, as may be seen by reference to M. C. Dareste's excellent 'Mémoire' on the

* Communicated by the author; having been read at the Bombay Branch of the Royal Asiatic Society, January 14, 1858.

subject*. Besides red, spots of white, yellow, green, and brown water have been seen in different parts of the globe; but those of red and white are most common in the Arabian and Red Seas, and of these two the red will chiefly occupy us here. They are of transitory duration, and, so far as the red colour is concerned, receive explanation from what occurs at our own doors, viz. in the sea-water pools left by the reflux of the tide on the shores of the Island of Bombay. A person casually looking at one of these pools, would say that a quantity of vermilion or minium had been thrown into it; but, on examining the water under a microscope, the colour is seen to be owing to the presence of red animalcules, whose name is *Peridinium.* These are not all red, however, for there are many green ones among them; and the latter are further observed to be but a transitional state of the former. This, then, is the cause of the red colour, and its sudden appearance and disappearance may be explained as follows:—

During the first or active part of the *Peridinium's* life, its green colour, which depends upon the presence of a substance closely allied to, if not identical with, the chlorophyll of plants, is, with the other internal contents, translucent, and therefore reflects little or no light; but gradually, as the time approaches for its transition to another state, called the motionless, fixed, or Protococcus-form, a number of semi-translucent, refractive oil-globules are secreted in its interior, directly or by transition from starch, the green colour disappears, a bright red takes its place; this mixes with the oil, and thus the little animalcule finally becomes visible to the naked eye, and the whole of that portion of the sea charged with them, of course, acquires a deep vermilion colour. This colour, however, only lasts for a few days, for they soon assemble together, become individually capsuled, like *Euglena viridis,* and in this state float on the surface or sink to the bottom in the motionless, Protococcus-form mentioned. Here duplicative subdivision takes place in several of the capsules, producing two or four new ones from the old *Peridinium,* each of which, on their liberation, may again become capsuled and undergo a further division, and so on, probably, until their formative force is expended, and they thus pass into dissolution;—or a litter of diplo-ciliated monads may be developed in a distinct cell in their interior, which may be the product of a true act of generation, or the final formative effort of the protoplasm,—a point to which I have already called attention in many of the Algæ and Infusoria; while the remainder of the red oil and internal contents which are not required for the nourishment of the monads become liberated with the latter on the bursting of the capsule, and thus dispersed in the water. A further con-

* Ann. des Sc. nat. 4 sér. Zool. t. iii. p. 179.

sequence of the fissiparation is the constant shedding of their capsules, which are always present with them in great numbers, and so brittle that pressure of the thinnest piece of glass bursts them, and again sets free the *Peridinium* when they contain one: iodine in dilute sulphuric acid gives them a deep violet colour, and the red matter of the *Peridinium* is also frequently rendered deep blue by the same solution.

Thus we see that the red colour is produced by the formation of oil reddened at the expense of the green chlorophyll. The same process takes place in the little *Protococcus* which I have heretofore shown to impart the red colour to the salt in the salt-pans of Bombay; and, again, in a freshwater animalcule closely allied to *Peridinium*, viz. *Euglena viridis* (probably Ehrenberg's *E. sanguinea* is but a reddened state of the latter); while a more familiar illustration than any is presented to us by the red colour which the leaves of some trees assume towards death, viz. the passing of the green chlorophyll and oil into a yellow, brown, and then red waxy substance; from whence we may also infer, that like changes in the *Peridinium* give rise to the prevalence of one or other of these tints in the coloration of the sea.

The species of *Peridinium* now more particularly under our consideration I described several years since in its fixed form (as it was submitted to me) undergoing fissiparation*; but never having met with it again in its active state until the 26th Nov. last, my attention was not again drawn to the subject, nor did I until then know what the animalcule really was. I shall call it animalcule, though, like *Euglena* and all this class, it really belongs much more to the vegetable than the animal kingdom; and, believing the species to have been hitherto unrecognized, its description, under the designation of *sanguineum*, may stand as follows:—

Peridinium sanguineum, nov. sp.

Subcircular when green, becoming larger and paraboloidal or kite-shaped when red. Compressed, sulcated on one side; surrounded transversely by a deep groove, the anterior lip of which is minutely ciliated. Furnished with a long, large cilium, having a suctorial extremity, which extends backward from the groove on the sulcated side. Body lined with granular protoplasm and chlorophyll, in which is a hyaline vesicle with a red eye-spot and a nucleus as in *Euglena*. Chlorophyll becoming of a golden yellow, then brownish, and lastly vermilion- or minium-red, as the animalcule passes into the Protococcus-state. Progression waddling, the small end forwards,

* Dr. Buist, "On Discolorations of the Sea," &c., Proceedings of the Bombay Geographical Society, 1855, p. 109.

and the large cilium floating behind. Capsule slightly tabulated over the anterior or conical half, smooth over the posterior or round half, which also bears a short sheath in its groove for the long cilium. Length 5 to 8-5600ths of an inch.

Found in salt-water pools, and in the sea on the shores of the island of Bombay.

What, then, accounts for the red colour of the sea and salt in the salt-pans at Bombay may account for the red colour in the sea-water of other parts, although the animalcules may not be the same,—viz. the formation of red oil in their interior. It is interesting, however, to find Darwin's description of the animalcule which he found to colour the sea red, a degree south of Valparaiso*, accord exactly with that of *Peridinium,* as may be seen by comparing our descriptions; while it is not less so to find Salt† stating that the animalcules which produced the red colour in the Red Sea (15° N.) during the day, became luminous and threw out sparks by agitation after dark; because most of Ehrenberg's marine *Peridinæa* are phosphorescent. In further confirmation of which, Olafsen and Povelsen's statement may be adduced respecting the red colour of the sea on the shores of Iceland, viz. that in 1649, in several gulfs, "the night before, the sea appeared all on fire, and the day following as red as blood." But it is not necessary for me to cite here all the observations in M. Dareste's 'Mémoire' in favour of the red colour of the sea being in many instances owing to the presence of *Peridinæa,* or the white colour to the same animalcules; suffice it to state that there are many.

With the explanation of the red colour, then, we have that of the white, which is only seen at night, and appears to be produced by phosphorescence generated in the midst of the oil-globules, becoming less and less powerful probably as the *Peridinium* becomes redder and more nearly approaches to the fixed or Protococcus-form. I do not of course allude here to the colour of what is termed 'whale-water,' or to the accumulation of any molluscous animals that can be seen with the naked eye, but exclusively to the colour of water produced by animalcules, which also must again be distinguished from those that are feeding on them, for where the former abound the latter are also sure to be present. Here I have to express my regret that I allowed the red water under consideration to pass away before I thought of ascertaining if the *Peridinium* which coloured it was also phosphorescent.

Again, the yellow colour may be produced by the chlorophyll

* Journal on board H.M.S. 'Beagle,' p. 17.

† Voyage to Abyssinia, p. 195.

passing into a golden tint, when the oily appearance, so often noticed on the surface of the sea, might be produced; so also the green colour may precede the change into brown and red, as stated in parts of the 'Mémoire' under reference, extracted from Parry and Scoresby's journals. Scoresby, too, notices that the animalcule was "paraboloidal," and he gives measurements equally small with those of a *Peridinium*.

On the brown colour a word also is necessary. This, which probably depends on the presence of a *Peridinium* in the sea, certainly does so on land, for I have had ocular demonstration of it in a freshwater tank at Bombay, where, in the beginning of February 1857, it not only turned the water quite brown, but imparted a smell and insipid taste to it, which almost rendered it undrinkable. Professor Allman has described the same phænomenon from equal evidence, in the ponds of the Phœnix Park, Dublin*; but the figure he gives of that *Peridinium*, though very like, is not the same as that of the species of Bombay.

Nor should I omit to notice here the æruginous green colour which frequently occurs in our tanks, from the presence chiefly of a little Alga called *Flos-aquæ*, with which the acicular, fusiform *Aphanizomenon Flos-aquæ* (Linn.) and curled-up, bead-like *Monormia intricata* (Berk.) are plentifully mingled. This occurs so generally and so abundantly, as frequently to render the water not only undrinkable, but to produce an intolerable stench by its putrefaction—facts which we cannot help associating with the blood-red water of Egypt; and when we add to this the following passage from an eye-witness of a similar occurrence at Porebunder, on the coast of Khattywar, where red water is extremely common, viz. "the colour of the sea-water on Saturday evening last, the 27th October, 1849, was changed from its usual tint to a deep red, emitting a most foul smell; the fish speedily were all destroyed, and were washed upon the beach in large quantities, &c.†"—we cannot help ascribing this, independently of the conjecture of the narrator that it might be owing to "some submarine eruption of mud, &c.," to the process of oleaginous development and change of colour above mentioned in some animalcule, most probably a *Peridinium*, and of realizing, at the same time, the (to me) previously incomprehensible Mosaic account of the plague of Egypt given in the following verses:—

........."and all the waters that *were* in the river were turned to blood."

"And the fish that *was* in the river died; and the river stank, and the Egyptians could not drink of the water of the river; and there was blood throughout all the land of Egypt."—*Exodus*, vii. 20, 21.

* Trans. Microscop. Soc. Lond. vol. iii. 1855.

† Proceedings Bombay Geograph. Soc. *loc. cit.*

XXIV.—*On the Investigation of Vegetable Tissue by the aid of Polarized Light.* By H. von Mohl.

[Concluded from p. 209.]

A new and surprising series of phænomena is produced when the polarized pencil of light is made to pass through a doubly-refractive medium, for instance, a thin plate of gypsum, mica, or rock-crystal*, &c., in its way from the lower Nicol to the object to be investigated. If these plates are so placed that their neutral axes are directed obliquely to the Nicol (best at an angle of 45°), the field appears more or less illuminated according to the thickness of the plate used, and, if the plate has a certain thickness, to be determined by trials, the field assumes one of the colours of the Newtonian rings. The microscopic observation made by the help of this modified light is of a mixed kind, because the object is, on the one hand, seen in transmitted light as in the ordinary microscope; on the other hand, this light is on its own part again modified by the substance of the object, and in consequence of this the object appears, as in the cases above examined, as a self-luminous body, its various parts at the same time presenting bright tints of complementary colours according to their position in relation to the selenite-plate and to the Nicols. It is well known that this arrangement is made use of for the detection of weak degrees of doubly-refractive power, since many objects which do not reveal this power by mere application of two Nicol's prisms, are shown to be doubly-refractive bodies on the interposition of such a plate, by their peculiar colour differing from that of the field. It is not this arrangement, however, which I here wish to discuss, but the fact, hitherto overlooked, that there exist, in the behaviour of vegetable membranes to polarized light, variations analogous to those between positive and negative crystals, and that these variations stand in connexion with chemical distinctions in the vegetable organs.

This phænomenon may be observed either in annular structures or in transverse sections of smooth cell-membranes. Between the lower Nicol and the object is placed a plate of selenite, which renders the field red; this plate is so rotated that its neutral axes form an angle of 45° with the Nicols. If the microscope is now focussed to an annular object, for example, the cross-section of a cylindrical cell, this is seen divided into four quadrants, which appear tinged brightly with complementary colours in this way: the two alternate quadrants whose

* I shall give details respecting the choice and application of these plates in a future paper describing the arrangements of the polarizing microscope.

middle line corresponds to one of the neutral axes of the selenite-plate are either blue or green, the other two yellow or red. If the selenite-plate is rotated so far that its neutral axes are perpendicular to the Nicol, all the colours are lost, and they reappear on the continuation of the rotation, but in reverse order, the quadrants previously blue now appearing yellow, and *vice versâ*. This alternation is repeated at each quarter of a revolution.

When the object used is the transverse section of a cellular tissue with rectilinear side-walls, all the cell-walls which stand perpendicular to one of the Nicols will exhibit the colour of the field; all those which run parallel with one of the neutral axes of the selenite-plate, or form no great angle with it, will be blue, and those parallel with the other axis yellow. When we direct our attention to the concentric lamination of the annular cell-membrane, and the rectilinear of the membranes of polyhedral cellular tissue, we find that in both objects the same colour occurs in the lamellæ of the same direction.

But if we compare (of course without changing the position of the selenite-plate; keeping also constant attention to the identical direction of the lamination of the organ) vegetable elementary organs of various kinds, in reference to colour, we find that they fall into two classes, which are contrasted in regard to the colours which they exhibit under the given circumstances. In one class all the layers which lie obliquely in the direction of a right-wound screw, are coloured blue (or green), those lying in the direction of a left-wound screw-line, yellow (or red); in the second class the colours are opposite for the same directions; the organs of one class are optically positive, those of the other optically negative.

To the optically negative class belong the membranes of all elementary organs situated in the interior of a plant, whether they be left in their natural condition, or cellulose be purified from the infiltrated substances by the help of nitric acid and chlorate of potash. In this respect agree not only ordinary cells and vessels, but even structures whose substance is assumed by many chemists to be essentially different from cellulose, for instance the medullary cells of *Sambucus nigra*, the mucilaginous secondary layers of the hairs of the seeds of *Acanthodium spicatum*, the cells of Lichens and Fungi, collenchyma-cells, the horny endosperm of *Phytelephas*, the cells of the cotyledons of *Schotia speciosa*, the gelatinous cells of the Algæ, for instance of *Bangia atropurpurea*; finally, among the parts lying nearer to the surface, the fibrous cells of the envelope of the roots of Orchideæ and Aroideæ.

On the other hand, optically positive colours are exhibited by

the cell-membranes of the periderm and the cuticular layers of the epidermal cells. This occurs, for instance, in common cork, in the periderm of *Quercus Cerris, Prunus virginiana, Æsculus Hippocastanum, Betula alba,* and in the thin cork-layers which divide the bark of old trunks of *Pinus,* e. g. *P. nigricans,* into scales. In the epidermis all those membranes which are coloured blue by iodine and chloride of zinc, like an ordinary cell-membrane, behave in optical respects also like a cellulose membrane; while all those layers which are coloured brown by those reagents, like the cell-membranes of the periderm, are optically positive. It here makes no difference whether the cuticle forms but a thin pellicle on the outer surface of the epidermis, as in most thin-walled epidermal cells (*e. g.* on the rhizome of *Polypodium aureum,* in the stem of *Impatiens,* of *Euphorbia Caput Medusæ,* on the leaf of *Helleborus fœtidus,* &c.), or, as in thick-walled epidermal cells, a thick stratum of the lamellæ on the external wall of the epidermal cells, and parts of their side-walls, possess the property of cuticle,—as, for instance, in the leaves of *Cycas revoluta, Phormium tenax, Hakea gibbosa,* and *Aloe obliqua,* and in the stems of *Viscum album* and *Misodendron.*

This contrast between the cuticular layer and the parts of the cell-wall composed of unaltered cellulose, may be observed with extreme clearness in the epidermis of the leaf of *Aloe obliqua.* Seen from the surface, the epidermal cells appear as tolerably regular hexagons, in whose side-walls may be distinguished the primary membranes and a thick deposit of secondary layers. Among the latter, even without the application of polarized light, the innermost, rather thick layer is distinguishable by being separated from the rest by a sharp line of separation. On the application of a plate of selenite, the primary membranes, and, with the exception of the said innermost, likewise the secondary layers which lie parallel with the neutral axis of the selenite-plate, appear, according to the thickness of the plate used, red or yellow; those lying parallel with the other neutral axis green or blue; while the innermost layer exhibits, with the same regularity, the complementary colours of the other membrane lying parallel with it. The same contrast in the colour of this innermost layer and the rest of the layers, is exhibited in the transverse section of the epidermis, in which it is further observed, that this innermost layer is continuous with the unaltered cellulose membranes of the posterior inner half of the epidermal cells, and in its colour obeys the rule followed by these membranes and the subjacent parenchymatous cells.

I have demonstrated, on a former occasion*, that the chemical

* Scientific Memoirs, 2nd series, Nat. Hist. i. p. 95.

difference of the cell-membranes of the periderm and the cuticular layers of the epidermis, their incapacity to take a blue colour with iodine and sulphuric acid, and their resistance to the solvent action of sulphuric acid, do not depend upon their consisting of a constituent substance different from cellulose, but that their basis is likewise cellulose, and that this appears with its characteristic reaction with iodine, when the compound deposited in these membranes has been removed by caustic potash. Hence it required to be examined whether these membranes could be made to recover, by the same treatment, the property of acting upon polarized light in the same way as cellulose. Some experiments made with the epidermis of *Aloe obliqua* showed that this is the case completely; for even after only a few hours' maceration in solution of caustic potash, the reaction had changed perfectly into that of cellulose. Treatment of the cuticle with oxidizing agents, for instance with a solution of chromate of potash in dilute sulphuric acid, had the same effect, but less perfectly, even when the maceration in this fluid was prolonged for several days. There is no doubt, therefore, that the optical reaction of the cuticle, like its chemical reaction, is to be ascribed to the deposition of a foreign substance in its membranes composed of cellulose.

In the conversion of cotton into gun-cotton there is a change of the optical conditions analogous to that of the cellulose layers of the epidermis in their conversion into cuticular layers.

The same opposite action on polarized light to that of cellulose which is found in cuticle, is seen also in the cell-membrane of *Caulerpa* (I examined in this respect *C. prolifera*, *Freycinetii*, *clavifera*), and this not only in the tough, external, lamellated cell-membrane of the stem, the leaves, and the radical fibres (if these expressions may be used to denote the parts of a unicellular plant), but also in the substance of the branched struts which run across the cavity of the plant.

The cell-membrane of *Bryopsis*, which I examined in *B. Balbisiana* and *penicillata*, displayed an anomaly I could not explain in reference to the rest of the conditions. It consists of many concentric layers, and its substance, with the exception of the external cuticular investment, is rapidly coloured blue by iodine and chloride of zinc, like cellulose; yet only a thin external layer acted like cellulose in polarized light, and all the inner layers in the contrary way.

Finally, the starch-granules of all the plants I examined in this respect have the optical behaviour opposite to that of cellulose.

When we turn from the examination of cross-sections of cells to the elucidation of the phænomena which cells present when viewed laterally, a far greater multiformity is met with.

The longitudinal section of the cell-wall behaves to polarized light exactly like the cross-section; hence, on the application of the plate of selenite, the same colours make their appearance, according to its position. But it is far less easy to observe this phænomenon in its purity here, than in examination of cross-sections, because the preparation of delicate longitudinal sections of uniform thickness, especially of prosenchymatous tissues, is far more difficult than the cutting of good cross-sections. Too thick a slice produces colour even by itself, whereby the colours produced by the plate of selenite are rendered more or less impure. A further disturbance frequently arises out of the circumstance that the longitudinal section often takes the side-walls of the cells in an oblique direction, the sections curve round, &c., from which irregularities the colours not rarely undergo alteration, even into the complementary colours. All this renders the examination more difficult; but when good preparations are examined, the above rule will be found confirmed.

Those side-walls of cells which are viewed from the surface, and are traversed by the polarized light in a perpendicular direction, exhibit extremely diverse aspects according to the variations of their structure. To observe these phænomena in perfect purity, it is best to select such elementary organs as have their secondary membranes split into fibres,—best of all, spiral vessels. Among these, the spiral vessels of the scape of *Musa paradisiaca* afford an unsurpassable material, since they are easy to isolate, of considerable size, and regular structure. When one of these vessels, its spirals being drawn somewhat apart, is placed with its long axis in a position perpendicular to one of the Nicols, the fibres on the upper side of the vessel ascend towards the left, those of the under side towards the right, and when the selenite-plate is interposed, they exhibit the complementary colours. If the colour of one of the strata of fibres is compared with the colour of a section of a cell-wall which is placed in the same direction with the fibres, an agreement in colour is displayed. If the vessel is rotated horizontally so far that the fibres on one wall come to lie perpendicular to one of the Nicols, the colour of these fibres vanishes so far as they lie in the said direction. It is clear, therefore, that in these fibres one negative axis lies parallel with their longitudinal extension, the other perpendicular to this. It is then very easy to explain why spiral vessels which are inclined with their longitudinal axes at an angle of 45° to one of the Nicols, exhibit a totally different aspect, according as their fibre describes a more or less steeply-ascending spiral. Three cases may be distinguished. When the spiral-fibre describes a very slightly-ascending spiral, when therefore

the fibres approximate to the position of transverse fibres, in the above-mentioned position of the vessel, the fibres of the anterior and posterior walls act in the same way upon polarized light, and the vessel appears of the same colour behind and in front, like a cell clothed with cross-fibres, or like a section of a cell-wall passing at right angles to the long axis of the vessel. When the spiral vessel is so far drawn out that the fibres of its anterior and posterior walls cross at right angles, in the oblique position of the vessel above mentioned they will stand perpendicular to the two Nicols, and consequently will not act upon polarized light. When, lastly, the vessel is so much drawn out that the fibres form a very acute angle with the longitudinal axis of the vessel, they act like longitudinal fibres, and hence appear with the complementary colours of those tints which are exhibited by the fibres of a closely-wound vessel.

It need scarcely be specially mentioned that the behaviour of spiral vessels is shared by cells which contain spiral fibres, for instance the elaters of the Liverworts, the leaf-cells of *Sphagnum*, the cells of the sporange of *Equisetum Telmateia*, the elaters of the same plant, the spiral cells in the stem and petiole of *Nepenthes*, those of the Orchideæ, &c.

Completely analogous conditions are observed in those elementary organs whose secondary fibres form a more or less regular network, as in the reticulated vessels of the Monocotyledons, the scalariform ducts of the Ferns, the reticulated parenchyma-cells of the wing of the seed of *Swietenia Mahogani*, &c. Of course the fibres here do not agree in colour in any position of the cell, but exhibit, according to their varied positions, the same colours as the cell-walls in the section of a parenchymatous cellular tissue.

As is well known, we find transitions from those cells which have the secondary layers divided into separate fibres, to the apparently homogeneous cell-membranes, or structures of that kind where the secondary layers are not composed of separable fibres, yet possess a fibrous structure, indicated by a finer or coarser striation, and are more easily torn in the direction of these streaks than in any other direction. This condition gave rise to the notorious dispute whether or not cell-membrane is composed of primitive fibres.

Among unpitted cells with fibre-like striation of the membrane, many Confervæ, for example *C. Melagonium*, and further, the *Cladophoræ*, are well known to be remarkable for the circumstance that they exhibit two systems of such streaks, crossing at right angles. It was a question here whether one alone of these systems determined the optical character of the membrane, or the two exerted an equal and opposite effect, mutually neu-

tralizing their action, as occurs in two cross plates of mica. Observation shows that the former is the case, and that the colour which the membrane exhibits on the application of a plate of selenite depends on the direction of the longitudinal striation. The direction of this striation is not the same in all *Cladophoræ*. In some, as in *C. glomerata* and *longissima*, one system of striæ, determining the optical conditions, runs parallel with the long axis of the cell; hence the cell-membrane of these species appears colourless when the cell is placed perpendicular to the Nicols, and in an oblique position exhibits the same colours as a section through a cell-wall lying parallel with the cell. In other species, as in *C. hospita*, the longitudinal striæ run in the direction of a steeply-ascending spiral, and the action of the light is altered accordingly.

In an analogous way, the cell-membranes of the Characeæ also exhibit two systems of streaks, crossing at right angles. But the striation is different from that of the *Cladophoræ*. It does not present, as in them, uniform and parallel lines, but the cells appear traversed in a transverse direction by fine streaks, which form a network with long meshes, while thicker bundles of fibres run longitudinally, often exhibiting an undulating course. This condition occurs both in the central cell of *Chara*, for example in *C. equisetina*, Kütz., and in the cell-wall of *Nitella*, for instance in *N. flexilis*, *mucronata*, *fasciculata*, and *syncarpa*. These membranes act very powerfully upon polarized light, but, what is remarkable, they exhibit in the same positions the opposite colours to those of the *Cladophoræ*. This might give rise to the conjecture, that the *Charæ* form, in regard to the optical conditions of their cell-membranes, similar exceptions to the general rule to those in *Caulerpa*; but the examination of transverse sections of *Nitella fasciculata* and *Chara equisetina* did not confirm this, for these behaved exactly like the transverse section of an ordinary cell. Since, then, on the lateral view of the cell the colouring is the opposite of that of the cell-membrane of *Cladophora*, and agrees with that of a spiral vessel with a very gently-ascending fibre, it is clear that in the *Charæ* the optical character of the membrane is determined by the transverse fibres.

Phænomena exactly analogous to those of cells in which the membrane has visible fibre-like streaks, are exhibited by cells in which only traces of this appearance are to be detected, or whose membrane appears to be completely homogeneous; since their membrane, according to the direction in relation to the Nicol, is sometimes invisible, sometimes more or less brightly illuminated, and, on the application of the selenite-plate, developes a yellow or blue colour. Here exists, on the one hand, evidence that the

apparently homogeneous cell-membrane is not really so; and on the other hand, the position in which the cell must be placed in order to be visible, and the colour produced by the selenite-plate, enable us to ascertain the direction of its invisible fibrillation. In this respect, for example, isolated vessels from the trunks of Tree-ferns are very instructive: on their membranes occur largish spots, smooth and perfectly homogeneous, corresponding to the angles of adjacent cells; on the application of the selenite-plate, these exhibit the same colour as the fibres running between the pits, and hence demonstrate that the entire membrane has a fibrous structure in the transverse direction. Beautiful examples of this are furnished also by the wood-cells of the Coniferæ and Cycadeæ, in which, very frequently, even when a definite fibrillation is not indicated by striation of the membrane with the ordinary microscope, the direction in which the fibres* run may be determined by the angle at which the slits of the pits stand obliquely to the long axis. This angle amounts, for instance in the wood-cells of a *Cycas*, to nearly 45°. If the cells are placed perpendicularly to one Nicol, these membranes appear, according as the fibres are directed to the right or left, either blue or yellow; on the other hand, they become colourless when the cell is inclined at an angle of 45° to the Nicol, while in this position the illumination and brilliancy of colour of the side-walls standing perpendicular to the surface of the object-slider attain their maximum. An analogous behaviour is exhibited by the cells of *Torreya taxifolia*, whose fibres ascend at an angle of 70°, and the cells of Fir-wood, with an angle of 68°,—only these, for reasons readily explained, did not show the greatest brilliancy of colour when the cell was placed perpendicular to a Nicol, but when it was so far inclined that its fibres formed an angle of 45° with the Nicol.

Peculiar phænomena are exhibited by the lateral borders of a cell containing an oblique or transverse fibre on its walls. The longitudinal section of a cell-wall behaves to polarized light, as above noticed, like a transverse section of the same; and the same holds good, in spiral vessels, annular vessels, scalariform ducts, &c., of the side borders at which the fibres of the anterior side curve downwards to reach the posterior side. In consequence of this, the fibres present, at the places of curvature, sometimes the same, sometimes the opposite colour from that of the fibres running on the horizontally-lying lateral surfaces, according as the latter ascend in a more or less steep spiral.

* When I speak here and in other places of *fibres*, I do it for the sake of brevity of expression, and by no means thereby intend to defend the doctrine of the existence of primitive fibres.

When, for example, a spiral vessel with a gently-ascending spiral is inclined at an angle of 45° to one of the Nicols, and thus the fibres of its posterior and anterior sides react in the same way on polarized light, in the manner of transverse fibres, appearing of a yellow colour, the places of curvature of the same will be blue, thus appearing of the same colour as if the lateral walls were composed of longitudinal fibres. The places of curvature appear of the same colours if the fibres of the anterior and posterior sides ascend at an angle of 45° to the longitudinal axis of the vessel, and in consequence of this, in the said position of the vessel remain uncoloured. When, on the other hand, the fibres describe a very steeply-ascending spiral, and the fibres lying on the posterior and anterior sides of the vessel thus act in the manner of longitudinal fibres, their colour agrees with that of the places of curvature. Constant and regular as these phænomena appear when we examine organs of very regular structure, like spiral vessels, in examining thick-walled cylindrical cells, for instance the hairs of *Boragineæ*, or isolated prismatic cells, such as wood- and liber-cells, many exceptions will be found, partly because the latter are subject to much irregularity in the course of the fibres from the oblique, variously changing inclinations of the side-walls of the cells, partly because, as it appears, the direction of the fibres is not always the same in the different layers of one and the same cell, so that, for instance, it describes a less steep spiral in the outer lamellæ of the cell-wall than in the inner.

The phænomena which the cell-walls exhibit in polarized light undergo, again, manifold modifications when two cell-membranes with differently directed fibres lie immediately one over the other. This naturally occurs with extreme frequency in the cellular tissue of plants when the fibrillation of the cells follows a spiral direction, since in that case the fibres will pursue opposite directions on the coherent membranes of two adjacent cells. When two such membranes are viewed lying one over the other in a horizontal direction, the lower one, as a doubly-refractive substance, must exert upon the light coming from the Nicol an analogous although weaker influence to that of a plate of selenite, and the effect of this must be more or less clearly indicated in the phænomena presented by the upper membrane. An influence of this kind must likewise make itself felt even when the membranes do not lie immediately one on the other, but are separated by a greater or less space, as for example the upper and lower membranes of a cell by the cell-cavity. Here, again, the spiral vessels of *Musa* may be used as a suitable object, in which these phænomena may be observed with certainty.

If we examine a vessel, placed perpendicular to one of the

Nicols, which has suffered no compression, and which is so far drawn out that the curves of the upper and under sides stand about at right angles to each other, the greater part of the turns are freely exposed to the light coming from the lower Nicol, and the two layers of fibres only lie one over the other in triangular spaces at the points of curvature of the fibrous bands at the margins of the vessel. In such a vessel, as above remarked, when a plate of selenite is interposed, the oppositely wound fibres of the upper and lower sides appear in complementary colours. These colours present themselves in great purity in all parts where the fibres lie free, but appear dulled in the triangles above noticed. It here depends solely upon the focussing of the microscope which colour we produce in these crossing-places: if we focus carefully to the fibre of the upper wall, its colour (no matter whether yellow or blue) will be almost pure, and little affected by the colouring of the lower stratum of fibres, lying under these circumstances out of focus; on the other hand, if we focus through the upper stratum of fibres to the lower, this appears with its proper colour, without the upper stratum of fibres, which cannot now produce any defined image on the retina, producing any very great disturbance. Properly the colours of the two layers of fibres should completely destroy each other, and it cannot be doubted the light has undergone a modification in passing through the inferior layer of fibres, and again suffers it in the upper layer; but with the isolated position of the fibres produced by the longitudinal stretching of the vessel, this light forms but an inconsiderable portion of the total mass of light coming from the plate of selenite, and remains almost ineffective after traversing the path from the lower to the upper layer of fibres, so that no very striking modification of the colouring of the upper layer of fibres can make itself felt.

On the other hand, matters are totally changed when the vessel is pressed flat in the compressor, so that the fibres of the two layers come to lie one immediately above another at the crossing-points, where the light modified by the lower fibre then penetrates immediately into the upper fibre, without mixing with the light penetrating unaltered beside the fibres of the lower layer. Here the action of the two layers of fibres upon one another is in most cases most evident, but it is indicated in very various ways, according as the crossing of the fibres occurs or not at a right angle.

If the fibres cross at right angles, the effect upon polarized light exerted by the lower stratum of fibres is removed by the upper stratum, in the same way as happens with two plates of mica crossing at right angles; hence the fibres should be invisible at the crossing-points. Now, this does not, it is true,

occur quite strictly; but when the Nicols are used alone, the crossing-points appear more or less black, while the rest of the fibres appear white; and when the selenite-plate is interposed, the crossing-points exhibit the colour of the field, while the uncrossed portions of the fibres are coloured yellow or blue, according to their position. For reasons readily perceived, the want of colour at the crossing-points remains the same, however the preparation may be rotated in a horizontal direction.

But when the superposed fibres do not cross at right angles (no matter whether more acutely or more obtusely), the phænomena exhibited at the crossing-points are essentially different. When a vessel of such kind stands perpendicular to one of the Nicols, the right-ascending spiral will appear in the complementary colour of the left-ascending spiral, as in an uncompressed vessel, so far as the fibres do not overlie; but at the crossing-points the lower stratum of fibres shows through the upper with its proper colour (no matter whether blue or yellow) almost unaltered, while the upper stratum is scarcely seen. When, however, such a vessel is placed at an angle of 45° to the Nicol, when the layers of fibres appear of the same colour, the effects of the two fibres are added together at the crossing-points, and at these places we find an analogous, but brighter, colour than that of the free part of the fibres,—bright yellow instead of dull yellow, bright blue instead of dull blue.

In the spiral vessels prepared in the above manner, the fibres of the upper and under sides act with equal force upon polarized light on account of their equal thickness, and the course of the fibres is perfectly regular: an equal regularity of the phænomena there presented will not easily be found in the examination of two adherent walls of adjacent cells, because here the unequal thickness of the cell-wall and the irregular course of the fibres diverted by the canals of the pits, produce disturbances, whence the colouring of the cell-walls frequently becomes unequal, and even complementary colours are found in neighbouring parts. This is the case in a high degree in thick-walled cells of somewhat irregular form, as in liber-cells.

Finally, it must be mentioned, in reference to the cell-wall penetrated in a perpendicular direction by polarized light, that in many cases, as already noticed by Schacht, the vicinity of a round pit is distinguished by a black cross similar to that exhibited by the cross-section of cylindrical cells. This cross is most strikingly seen in the border which surrounds the pit of Fir-wood; it occurs, less sharply defined externally, on the pits of the endosperm of *Phytelephas*, of Palms, and on many wood-cells. The origin of this cross is easily explicable, from the fact that the fibres of the membrane are diverted round the pits in

circular curves, to which is added, in the pits of Fir-wood, the circumstance that the cell-wall is protruded inwards into the cell, in a globular form, over the cavity which forms the border of the pit.

Passing from the cell-wall to the cell-contents, we find that the behaviour of starch-granules with polarized light has already been investigated by so many persons, that scarcely any notice will be required respecting it. It is universally known that they show a black cross, like the transverse section of a cylindrical cell; that the point from which the arms of the cross run out always coincides with the organic centre of the granule, with the so-called hilum; that the arms of the cross stand perpendicular to the lamellæ of the granule, and that therefore the cross is often exceedingly irregular*, from the excentric arrangement so frequently presented by the lamellæ (most strikingly in the starch-granules of the tubers of *Canna indica*, of Galanga-root, of the milky juice of *Euphorbiæ*, &c.). I have likewise explained above, that the colours which the starch-granules exhibit on the application of a plate of selenite, are *positive*, and opposite to those of cellulose. The swelling-up of starch-granules in boiling water, strong acids, or caustic alkalies, removes from their substance the power of acting upon polarized light (at least in a degree capable of detection with our instruments). It offers a very attractive spectacle to observe this process in the starch of the Potato with the application of a selenite-plate. When a drop of solution of potash is added to the water in which the granules lie, the latter swell from without inwards: as far as their substance remains yet unattacked, it exhibits the most vivid colours; the swollen portion is quite sharply separated from the still hard parts, and during its expansion it exhibits pale colours, which vanish in the completely gelatinized parts.

In my opinion, inulin does not occur in the form of granules in the cells of living plants, but in solution. In the parenchyma-cells of dried roots of *Inula Helenium*, it presented itself in the form of irregular angular masses, not expanding in cold water, acting strongly upon polarized light, which possibly may depend simply upon mechanical tension. It was precipitated from the boiling solution in the form of small, irregular, roundish lumps, which acted only weakly and in an irregular manner upon polarized light.

I could not observe any effect upon polarized light in chlorophyll-granules or the chlorophyll-bands of *Spirogyra*. The starch-granules contained in them displayed the ordinary phæ-

* That particular observers, for example Pereira, did not see the black cross in the starch-granules of certain plants, for instance in the seeds of wheat and rice, is attributable to the imperfection of the instruments with which they observed.

nomena; but the green colouring matter is in a high degree obstructive to the development of a bright light, as is shown by the comparison of the chlorophyll of a leaf bleached by alcohol with a fresh leaf of the same plant.

In the granules of oleaginous seeds (Hartig's *aleuron-granules*) I could usually find no sign of double refraction; distinct traces were, however, displayed, on the application of a plate of mica, in the seed of *Attalea funifera*.

In the primordial utricle I ordinarily found no trace of double refraction. In the *Spirogyræ*, however, it exhibited, after contraction with weak alcohol, on the application of a plate of selenite or mica, a very weak but quite evident reaction like that of cellulose.

My observations on the last three structures are, as is evident, very insufficient; further improvements of the observing instruments are required in order to arrive at decided results respecting their behaviour with polarized light.

The polarizing microscope, even in its present condition, is excellently adapted for the discovery of crystals in plants, since these appear with surprising brilliancy on the dark field. Although it has been long known that crystals are very widely diffused formations in the vegetable kingdom, and that scarcely a plant exists, in the higher orders, in which they may not be discovered,—yet one is surprised, on the application of polarized light, to find the crystals far more frequent, and in far greater quantity, than one is accustomed to see on investigation with the ordinary microscope. The quantity of them in many Lichens, for instance in *Lecanora tartarea*, is quite surprising in amount; and they will likewise be found in the tissue of many embryos, where they would otherwise easily escape notice on account of their small size and the granular contents of the cells; but even in other parts where they have long been known and are more readily discoverable, they may be detected more easily and in greater quantity, and as crystals, in polarized light. I will mention, in reference to this, only the stellate hairs of the air-canals of *Nymphæa*, in each nodule of which lies a crystal, soluble in strong acid. The crystals mostly appear, even without the application of a selenite-plate, in brilliant colours; and there is not a more attractive spectacle than the view of a great quantity of [sulphate of lime?] crystals in the petiole of many Musaceæ, *e.g. Urania speciosa*, or of the larger raphides, such as are so common for instance in the tissues of the Aloes. Whether crystals occur which belong to the regular system, and consequently do not act upon polarized light, is unknown to me, but I have met with none hitherto.—(A. H.)

Tübingen, November 1857.

XXV.—*On the Nature and Origin of the External Coatings of Seeds.* By John Miers, F.R.S., F.L.S. &c.

The above question has not sufficiently attracted the attention of botanists, who have often described the seminal tunics under different appellations, according to their notions of the source of their development; but, in a paper published nearly two years ago*, I pointed out the test by which, as it appeared to me, their true origin can always with confidence be determined. Dr. Asa Gray has lately presented a paper to the Linnæan Society, in which he maintains the view he first enunciated respecting the seed-coats of *Magnolia*; in that paper this eminent botanist details his observations on the development and growth of its ovule, particularly in regard to the period when the osseous deposits are secreted within the primine; from these observations he still contends that the outer fleshy tunic of its seed derives its origin from the primine, and is therefore a portion of its testa. If this doubt were confined solely to the case of *Magnolia*, it would be of small moment, but as it affects a leading feature in the development of most other seeds, it becomes a question of extensive importance; and under this impression, as the facts described by my esteemed friend appeared to me to admit of a different solution, I soon after read a paper before the same Society, in which, carefully avoiding all controversial disputation, I briefly confined myself to a revision of the argument, bringing forward other facts and inferences, with a view of resolving the matter. The Council of that Society published Dr. A. Gray's paper, but, in a manner quite inconsistent with the spirit of scientific progress, refused a place to my observations in its Quarterly Journal, on the score that its 'Proceedings' are not a fit medium for contention on this point of science. I am fully aware how difficult it is to establish any novel views of structural development, and as I am desirous, for the cause of truth, that the matter in question should be decided, I submit it to the consideration of botanists, with the hope that they will throw aside for the moment their previous conclusions, and give their unbiassed attention to the facts and arguments here presented to their notice. With this view I will condense into another form the bearings of the whole question, introducing first a few premises, the import of which seems to have been lost sight of in this inquiry.

1. Vegetable growth in all its stages is regulated by the ordinary laws of mechanical action, and hence all inferences from seeming facts, or those often assumed to be facts, which are in-

* Linn. Trans. xxii. 81.

consistent with the operation of those laws, must be held to be founded in misconception.

2. Every tunic of the vegetable ovule is formed of three elementary parts; its outer and inner surfaces (epiderm and endoderm) consisting of a layer of very consolidated cells compacted with and enclosing a great mass of looser cellular tissue (mesoderm), from which they are not separable, as distinct pellicles, without laceration of their surfaces: these inner cells are filled with various substances that constitute pleurenchyma, &c., destined for the protection of the nucleus.

3. No communication of vessels can pass from the mesoderm of one into the mesoderm of another tunic, except through the common point of their origin.

4. There the mesodermal tissues of all are united, and are connected or are in communication with the secreting surface of the placenta; and I have distinguished by the name of *gangylode* this common point of junction of the coats and nucleus of the ovule.

5. When an ovule is erect, the gangylode is necessarily coincident with the point of attachment of the ovule to the placenta, and here all the nourishing vessels terminate; consequently there will be no future indication of the presence of any raphe in the tissues of the seminal tunics.

6. When the position of an ovule is changed by the act of anatropal inversion, the gangylode, or future chalaza in the seed, becomes far removed from the point of its prior attachment to the placenta; but an intimate communication is still maintained between them by an extension of a portion of the placenta (which I have called the placentary sheath) carrying with it and enclosing the nourishing vessels which constitute the future raphe in the seed. This placentary sheath, though confluent with the outer tunic of the ovule, is still a distinct formation; and no organic connexion, either then or afterwards, exists between their respective mesoderms, except through the medium of the

Fig. 1.

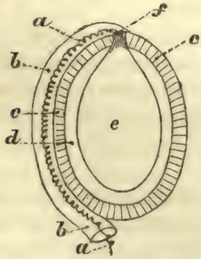
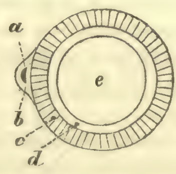


Fig. 2.



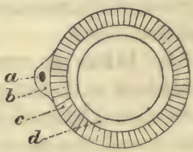
gangylode. Thus, in the annexed longitudinal and transverse

sections of an anatropal ovule, *b* is the placentary sheath, containing the nourishing vessels, *a*, proceeding from the placenta and terminating in the gangylode, *f*; *c* is the primine, *d* the secundine, *e* the nucleus. It is here manifest that the nourishing vessels enclosed in the placentary sheath never find their way into the tissues of the primine.

7. We may therefore infer, as an axiom from the three foregoing premises, that the raphe does not primarily, nor does it subsequently exist within the substance of the primine; and it is equally clear that if any penetration of the vessels of the raphe into its tissues were to exist, the natural course of such entrance would be only through the gangylode or chalazal point of the seed; but no such extension of the raphe beyond that point has ever been observed.

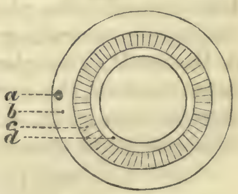
8. It is equally clear, in the course of the growth of the tunics of the ovule into the coats of a seed, that if there be no lateral expansion of the placentary sheath, then the raphe must be found as a distinct cord or compressed fistular line, remaining adnate to one side of the testa, exhibiting itself in transverse section as in the margin, where *a* is the bundle of nourishing vessels, *b* the compressed sheath in which it is enclosed, *c* the testa, *d* the tegmen.

Fig. 3.



9. But if we often find the vessels of the raphe imbedded within the substance of a distinct and entire fleshy coating which completely envelopes the two usual integuments of the seed, then the only conclusion we can draw is, that there has been a growth and extension of the placentary sheath, which has become enlarged into such a thick coating over the entire surface of the testa, as seen in the margin, where *a* shows the vessels of the raphe, *b* the extraneous fleshy coating or arilline, *c* the testa, *d* the tegmen. The testimony *à posteriori* presented by the appearances in the seed in this case, combined with the evidence *à priori* observed in the pre-existing ovule, convey certain proof of the intermediate growth and extension of this extraneous coating, as convincing as that of any demonstration in Euclid, even if no one had ever witnessed this expansion.

Fig. 4.



10. It is manifest that the period of the growth of this extraneous coating must have been subsequent to that of the act of inversion and fertilization of the ovule, and that it is therefore somewhat arilliform in its nature. This kind of coating, being

an expansion of the placentary sheath, I have called an *arilline**, to distinguish it from the true *arillus*, which is always more exterior to it, and not necessarily fleshy, and which is an emanation from, or growth of, the funicle. If the term *arilline*, which is identical with the *arillode* of Planchon and the *faux arille* of St. Hilaire, be objected to, it is easy to give it another name; but that coating, in no case, can be considered to be the *testa*, though sometimes confluent with it.

These considerations are perfectly consistent with the doctrines of Brown and Mirbel, now universally adopted by botanists, in regard to the development of the coats and nucleus of the ovule and the mode of its fertilization and growth.

The question in regard to the seed-coats of *Magnolia* having been fully discussed in my former paper †, I need only here refer to the main points at issue in that case. Dr. Asa Gray, having at first overlooked the existence of the inner integument, was led to conclude that the two outer tunics of its seed are the growth of the two coats of the ovule ‡; but he afterwards admitted that its bony shell must be held to be its testa §; at the same time, not prepared to renounce his favourite prepossession that the scarlet coating is a growth of the primine, he maintained that the two constituted one integral tunic, "a baccate testa:" this term, of no definite meaning, was invented by Linnæus, prior to the existence of any distinct nomenclature being given to the several tunics, and before their nature and origin were inquired into. Gaertner, in the use of this term as applied to *Magnolia*, explains that its testa is covered by a fleshy envelope analogous in its nature to that of an arillus, and in describing the seed of that genus, he defines its envelopes as consisting of three distinct tunics ||. Drs. Hooker and Thomson had in the meanwhile adopted the opinion of Dr. Gray regarding the outer seed-coats of *Magnolia*, and in this respect they differ from all preceding botanists¶.

* Linn. Trans. xxii. 89.

† Linn. Trans. xxii.

‡ Gen. Unit. States, i. 60.

§ Hook. Kew Journ. vii. 244.

|| De Fruct. Intr. 133; vol. i. 343; Linn. Trans. xxii. 86.

¶ This is denied by the reporter, in a marginal note made on my paper; but, with all the consideration due to that authority, I submit, as far as my memory extends, that I know of no one who has previously entertained the opinion of Dr. Gray, that this scarlet coating is the testa. Gaertner's definition, here alluded to, is dated 1788; and those who subsequently adopted the same expression would have explained their meaning, if they differed from that definition. Jussieu, however (1789), distinctly confirms Gaertner's explanation (Gen. Pl. 281), when he ascribes to *Magnolia* "semina baccata seu arillata." DeCandolle, in his 'Systema' and 'Prodromus,' adopts simply the same phrase "semina baccata," without further explanation. Spach (Phaner. vii. 469) says positively "arille charnu." Endlicher (Gen. Pl. 4737) also defines it "integumentum exterius carnosum

Against this combined authority I demurred, by showing * that the cord of the raphe being found within the scarlet coating, it was absolutely impossible, if that tunic owed its origin to a mere growth of the primine, that the raphe could have quitted its normal position outside the primine †, and have subsequently insinuated itself into its tissues.

Dr. A. Gray, in his last paper ‡, again repeats that the scarlet coating and bony nut are both derived from a growth of the primine, as he witnessed upon the inner surface of the latter the gradual deposition of osseous cells, subsequently forming the hard shell. There can be no doubt of the fact of this deposition, but I dissent from the inference just mentioned. If what my excellent opponent designates a "baccate testa" be one tunic resulting from the mere growth of the primine, we ought to find it consisting of three parts, as stated in my second preceding definition; but, on examination, we find double the number, or two distinct tunics, the outer having its endoderm and epiderm, which in the ripe seed I found a black and softer surface, easily scraped off, and showing the nut beneath of its usual pale yellowish colour. I will not enter into the question whether the previous growth of the primine is due to "merismatic division," as supported by Dr. Gray, or whether it is due to other sources, after the theories of different physiologists. But when it has attained to nearly its full growth, the mode of the solidification of this tunic is probably effected by means of the intercellular passages, so clearly indicated by Link, as existing between the cells of fleshy tissue; osseous matter, secreted probably from the nourishing vessels, would here readily flow into those spaces and become absorbed into or deposited round the cells of that tissue. By these means the whole internal mesodermal mass would become solidified into a compact hard shell, and the previously harder epidermal surface of the primine would now be comparatively the softer, and be readily scraped off the nut, as I found it in *Talauma*. This view corresponds with the structure observed in the ripe fruit; while, on the other hand, under the supposition of Dr. Gray, that the two outer seed-coats had previously existed under the form of one single homogeneous tunic,

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coloratum, testa subossea." Lindley (Veg. Kingd. 417), speaking of *Magnoliaceæ*, and referring to the tribe *Magnolieæ* as distinct from *Illicieæ*, remarks, "seeds often covered by an aril." The only botanist who speaks ambiguously on the subject is St. Hilaire, who says generally, that where the seed-coats are of different natures and confluent together, he will, for the sake of convenience, consider them as one.

* Linn. Trans. xxii. 86. † See the preceding second definition.

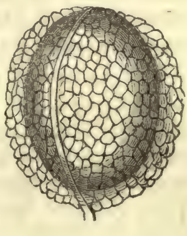
‡ Journ. Linn. Proc. ii. 106.

it would be impossible to assign any reasonable cause why the inner moiety of that tissue became solidified, while its exterior half escaped the same operation.

Dr. A. Gray suspects that I have "formed a wrong idea of the raphe*," and that I have "mistaken for the raphe in *Magnolia* the cord of vessels it contains;" and yet in a preceding page† he designates that cord (the only one existing in that seed) as the "conspicuous cord of the vessels of the raphe," and so figures it as I have done: this is an incongruity only attributable to a *lapsus calami*. The structure of the seed of *Pæonia* (as demonstrated in my paper) quite conforms with the views I have here entertained.

Dr. A. Gray, having watched the increment of the ovule, without being able to detect the growth of any extraneous coating over it, complains that this circumstance has not received its due weight‡; but I suggest, in fairness, how far a negative observation can be expected to preponderate against the positive testimony of the several high authorities who have witnessed and recorded similar developments. Having quoted some of these on a former occasion§, I need not here allude to the facts observed by Dr. Planchon, showing the successive growth of an analogous coating over the seed of *Euonymus*; also the gradual production of a similar tunic in the seeds of *Opuntia*; and, again, the progressive appearance of the same kind of fleshy envelope in *Clusia*. I also cited the minute details of Gasparini, who witnessed the same fact in *Opuntia* in the several stages of its growth. No one will feel disposed to question the still higher authority of the celebrated Mirbel, who minutely describes and figures this "production nouvelle," consisting of "deux couches de tissu cellulaire, qui n'appartient pas primitivement à l'ovule, mais qui s'applique à sa surface et finit par lui servir d'enveloppe comme ses tegumens propres." In this discussion we should not confine ourselves to the single case of *Magnolia*, but ought to be guided by analogy in other instances. With this view, I pointed to examples, such as *Zanonia* and *Feuillæa*, as types of numerous cases where the extraneous coating over the testa is membranaceous and expanded, and which cannot come under the category of a "baccate testa." I also alluded to the tunic in *Tacsonia*||, where the osseous testa of the seed is enclosed within a free, reticulated, membranous sac, upon which the cord of the

Fig. 5.



* Journ. Linn. Proc. ii. 110.
† *Ibid.* p. 108.
‡ *Ibid.* ii. 107.
§ Linn. Trans. xxii. 97.
|| Linn. Trans. xxii. 93.

raphe is visible, extending from the hilar point of the placentary attachment along one side of this sac to the opposite extremity: the only point of organic connexion between the testa and this sac is at the latter termination, where the vessels of the raphe penetrate the shell, to reach the chalaza of the inner integument. Will the advocates of Dr. Gray's hypothesis contend that this free outer membrane and the osseous shell are of identical origin, both resulting from the growth of one ovular tunic? Will it be denied that this free membrane is a production of the original placentary sheath, drawn away from the placenta with its nourishing vessels, and subsequently extended over the whole surface of the ovule?

Perhaps the most telling evidence in support of the view I have here endeavoured to maintain on the one hand, and against the opinion supported by Dr. Gray, on the other, is to be found in the case of *Euonymus*. Complete details of the gradual and progressive growth of the outer fleshy coating of its seed are recorded by Dutrochet*, who shows that it is not formed till after the impregnation of the ovule; that it first appears as a thickening about the hilum; it then becomes cupuliform, gradually extending itself over the ovular integuments, and finally is seen to envelope the whole seed. One of the most important features observed in the growth there described and figured, is that the vessels of the raphe are enclosed in the soft fleshy tissue of this extraneous coating: this coating has generally been regarded by botanists as an arillus, because of the indubitable fact of its subsequent independent growth, and because it is sometimes incomplete or open at one extremity,—a condition I have shown to be an insufficient element in constituting the true character of an arillus†. Dr. Asa Gray has, however, described and figured these same facts ‡, showing first the anatropal ovule of *Euonymus*, in fig. 6, with the lateral raphe in its placentary sheath agglutinated to the primine; figs. 7 & 8 exhibit the progressive increment of this fleshy coating over the primine, and fig. 10 its completion as an entire "pulpy red arillus." Now, according to this, his own evidence, if the raphe be at first agglutinated to the primine in the ovule, and it be afterwards found imbedded in this "pulpy arillus," which he acknowledges and figures as of extraneous growth, proceeding from the hilar point of its placentary attachment, how can the vessels of the raphe have left their first-shown position in the ovule, and subsequently have found their way into the tissue of the arilliform tunic? How can so manifest a development be explained

* Mém. du Mus. viii. 270. tab. 1. fig. 30.

† Linn. Trans. xxii. 83.

‡ Gen. Unit. States, ii. 187. pl. 171.

upon any other principle than that I have above demonstrated? The facts here shown are completely fatal to Dr. Gray's later conclusions. The outer fleshy seminal tunic in *Euonymus* certainly cannot be held to be a true arillus, as generally supposed, but an arilline; in all respects it is analogous to the fleshy coat in *Magnolia*. If, therefore, the outer seed-coat of *Euonymus* be acknowledged to be an arilline, or extraneous tunic distinct from the growth of the real ovular integuments, so, *pari passu*, must the scarlet coating of *Magnolia* be of the same nature: as the previous condition of the ovule, and the subsequent structure of the seed, are precisely similar in both cases, it follows as a necessary rule, that the nature and origin of these seminal tunics must come under the same category.

In order to render the fact of this expansion of the placentary sheath more palpable, I will proceed to demonstrate the manner in which the raphe is developed under other circumstances, which, though of ordinary occurrence, has been only cursorily alluded to on a former occasion*—I mean, a branching raphe. In this instance, the ovule before impregnation exhibits the usual appearance seen in the first of the preceding figures, with a simple lateral band enclosing the nourishing vessels; but during its growth into a seed, either these, or other vessels springing from the same source, spread themselves in dichotomizing branches over the whole surface of the integument, which is generally described as the testa; but if such vessels were really existing within the true testa, they would necessarily have entered its tissues at the point *b* of the chalazal extremity, whence spreading through its mesoderm, they would infallibly show, in the ripe seed, the appearance in the adjoining figure 6,

Fig. 6.

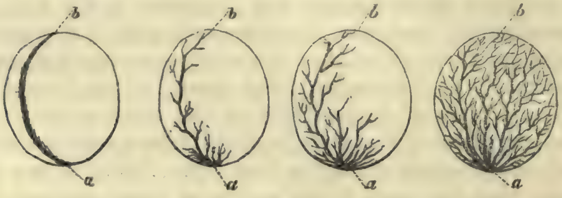
Fig. 7.

where *a* is the hilar point of attachment. On the contrary, I have invariably found, that the starting-point of this distribution of the vessels is at the opposite hilar or micropylar end of the seed, as in figure 7, where *a* and *b* refer to similar points. The development of this form of raphe is easily accounted for upon the explanation I have given, and the following figures will ex-

* Linn. Trans. xxii. p. 88.

hibit, in a more forcible manner than words can express, the gradual extension of the placentary film, carrying within its

Fig. 8. Fig. 9. Fig. 10. Fig. 11.



expanding tissues the branches of vessels, where they find ample room to spread and subdivide themselves in the manner seen. This explanation is conformable with the fact, and consistent with the usual rules of increment. But under the former assumption, that the vessels so disposed lie within the tissues of the real testa, we must suppose the annihilation of the primitive placentary sheath, and the production of a fresh set of vessels from the placenta, subsequent to the fertilization of the ovule, which must pierce an entrance through the epiderm of the primine, at a point near the micropyle, and which thence distribute themselves through the mesodermal tissue of that integument,—a supposition palpably absurd, and in violation of the ordinary laws of mechanical growth.

At other times, as in the Almond, the original cord of vessels does not throw out dichotomizing branches from its base, as shown above, but, following the expansion of the sheath, it becomes separated and distributed all round the seed into irregular bundles, which extend from the hilum to the chalaza, and which anastomose with one another at ganglionoid points, just as an entangled skein of thread appears when pulled out by a lateral strain. In *Amygdalus,* the arilline, testa, tegmen, and very attenuated albumen, are all confluent with one another, into apparently one tunic.

Those who are not satisfied with my explanation must be prepared to define upon consistent principles, which has never been attempted before, how and by what means the vessels of the raphe become distributed in the manner we find them. This increment of the placentary sheath appears to me incontrovertible. It is, however, a consideration that concerns not only the botanical, but the zoological physiologist; for if it be true that at a period immediately subsequent to the act of its fertilization, the ovule becomes covered with an entire film, which probably exerts some yet unknown and important function towards the future perfection of the embryo, it presents an exact analogy

with the animal ovum, where a similar coating is well known to be produced over it, exactly at a corresponding period.

In a separate paper*, I have pointed out many singular anomalies observable in the structure of seeds, that are not reconcileable with the ordinary hypothesis. I have since collected numerous other curious and novel facts tending to support my views, showing the unusual developments observed in the *Colletieæ* and in the *Rhamnaceæ* in general, the still more novel form of growth of the seeds of the *Anacardiaceæ*, the peculiar structure in those of the *Styraceæ, Canellaceæ, Winteraceæ, Lardizabalaceæ,* and several other families, of which, after patient research and careful investigation, I have prepared monographs, which in succession will appear in this Journal, and which will afterwards be reproduced in my 'Contributions' accompanied by numerous plates and copious analytical details. In most cases, in the above-mentioned families, the outer coating of the seed appears under the form of a crustaceous shell, exterior to, and quite free from a fleshy tunic, which encloses the cord of the raphe within its tissues: although the former coating is usually designated as the testa, it cannot under any hypothesis be considered as a development of the primine: it appears to me a perfect arillus,—satisfactory proof of which is offered in *Lardizabala, Lithræa,* and numerous other instances.

XXVI.—*Some Observations on Professor Agassiz's Criticisms on the "Catalogue of Shield Reptiles in the Collection of the British Museum."* By Dr. J. E. Gray, F.R.S., V.P.Z.S., P. Ent. Soc. &c. &c.

I have lately received, through the kindness of the author, a copy of Professor Agassiz's "Contributions to the Natural History of the United States: First Monograph, in Three Parts: I. Essay on Classification. II. North American Testudinata. III. Embryology of the Turtle, with thirty-four Plates," a highly valuable and very important contribution to the natural history of the Testudinata; and which is accompanied with a large number of remarkably well executed plates, showing the development of the embryo and the young animal of several species of the Testudinata inhabiting the United States, and some plates showing the change in the general colours of one of the species. In the Appendix and Errata to this work there occur, among observations respecting the 'Catalogue of Shield Reptiles,' the following remarks: "Among his [Dr. Gray's] North American *Emys* there are several which are only nominal species. I trust

* Linn. Trans. xxii. 97.

that the evidence I have adduced in the case of *Ptychemys rugosa* is sufficient to show that in some types the colour does not afford specific characters. This is the case to the same extent with *Ptychemys concinna,* which is mentioned under four different names by Dr. Gray,—as *Emys ornata, E. Floridana, E. annulifera,* and *Pseudemys concinna. Ptychemys Mobilensis* appears twice, as *Emys Mobilensis* and as *E. ventricosa. Ptychemys rugosa* also appears twice, as *Emys rivulata* and *Pseudemys serrata.* These facts are sufficient to show that Gray's genus *Pseudemys* is not well founded, as the two species which he himself had an opportunity of examining are only varieties of other species, which he refers to the old genus *Emys.* I am unable to refer his *Emys venusta* with certainty, as his figure, though well drawn, does not exhibit the generic characters. I believe it, however, to be one of the many varieties of *Ptychemys concinna.* The same remark applies to *Emys callirostris*" (p. 641).

I will proceed to examine these observations *seriatim.*

I am quite aware, from the examination of living specimens of *Emydes,* that they change considerably in colour as they increase in age, and under different local or accidental circumstances; that is to say, that the colours, which are very distinct and well defined in the young, become more diffused and obscure in the adult; but at the same time I have also observed that the disposition of the colours does not change, and for that reason, in the Catalogue above referred to, I attempted to divide the species of the genus *Emys* according to the system of colouring, that is to say, according to the disposition of the coloured rings or streaks, which are best observed in young specimens. It is this which renders the study of the young individual so important, and the want of sufficient attention to it by preceding herpetologists renders their figures and descriptions so difficult to identify; and I think that if Professor Agassiz had paid more attention to it, he would not have proposed to unite under one name species so distinct as those in the observation quoted.

I will now proceed to the second subject,—that I have mentioned one species under four names,—from which one would naturally suppose that I had described it four times over, after examination, which is not the case; for, as far as *E. Floridana* is concerned, I have only inserted it in the Catalogue on the authority of Leconte, Duméril and Bibron, Holbrook, and Bonaparte, who have all considered it as distinct. When the Catalogue was published, I had not been able to procure a specimen. As regards *Emys annulifera,* which is only described from a very young specimen without a habitat, and which may be African or Indian as probably as American, I can only say that I compared it

with young specimens of *E. ornata* and *P. concinna* of the same size, and was convinced of its distinctness, and I am certain that if Professor Agassiz had had the same opportunity (which he cannot have had, as the specimen has not been even figured), he would have come to the same conclusion as I have done,—and yet he gives his opinion on the subject *ex cathedrâ* without the slightest doubt. If he had compared the system of coloration, as I have done, of *Emys ornata, Emys annulifera,* and *Pseudemys concinna* in their young state, and *E. ornata* and *P. concinna* in their various states of growth, he never could have made such a statement that they were the same species, or have thought it possible that *E. venusta* and *E. callirostris* were only varieties of the same. Such random assertions are very injurious to the progress of science, especially when they profess to be made on special and mature study of the subject; and it is curious that Professor Agassiz, who has figured the young state of many of the North American species, does not appear to have properly estimated the important characters they present, or to have studied the manner in which the colouring is modified by the growth of the shields in the different species.

I have nothing to object to the proposal to unite *Emys Mobilensis* to *E. ventricosa,* except that the statement as made by M. Agassiz conveys a misrepresentation of the facts; for in the Catalogue, p.28, under the citation of *E. Mobilensis,* from Holbrook, I state, "The figures (Holbrook's) greatly resemble my *E. ventricosa,* but the margin is represented as having sutural spots, which is not the case in that animal. See No. 25;" and under "25. *Emys ventricosa,*" I quote "?*Emys Mobilensis,* Holbrook," as a synonym, and, in the observations, enter into particulars showing that they may probably be the same, as Mr. Holbrook's artist is not always accurate in the disposition of the colours of the lower edge of the shells.

In the Catalogue I make the following observation respecting *E. rivulata*: "I describe this species with doubt, as I have only seen a single shell, in its adult state, without the animal;" and I may observe, that its North American origin is even doubtful. The general form and structure of *Emys rivulata* is so exceedingly unlike any other *Emys,* that I was induced to describe it without waiting for other specimens; but since Professor Agassiz's observations, I have compared it with our nearly adult specimen of *Pseudemys serrata,* and there is a certain amount of resemblance between them; so that I will not take upon myself to say that they are certainly distinct; but if they are alike, the Museum specimen is a very remarkable variety.

I may observe, that as the shell from which the species was described is without its head or skull, and therefore does not

present the characters by which the genus *Pseudemys* is separated from *Emys*, its being retained in the genus *Emys* by no means shows that the genus *Pseudemys* is not well founded. But on this subject I will make my stand on the fact, that *Emys ornata*, which Professor Agassiz unites with *Emys venusta*, and *E. callirostris*, which he thinks may be the same as *Pseudemys concinna*, are true *Emydes*, and not *Pseudemydes*, according to the characters by which I have separated those genera in the work above referred to; and that these characters, founded on the form and development of the lower jaw, on the extent of the horny sheath of the lower mandible, and on the scaling of the feet, are more important anatomical characters for the foundation of a genus than those used to distinguish the many genera into which Professor Agassiz proposes to separate the American *Emydes*,—if they have any characters at all; for it is to be observed that Professor Agassiz does not give any synoptic characters for the families, subfamilies, genera, or species, but only indefinite general observations.

It is curious that Professor Agassiz, who has so minutely subdivided the genera of the North American *Emydæ*, and described so many new species, should have so completely overlooked these important characters, both in his description and figures, that he has proposed to mould into one species the animals belonging to such distinct genera, founded on characters that must have an important influence on the habits of the species.

Further on, Professor Agassiz observes:—"Gray describes two Cinosternons from North America as new species, founded upon young specimens. I confess my inability to distinguish them from *Cin. Pennsylvanicum*. *Cin. punctatum* seems to me to be the young male, and *Cin. Hippocrepis* the young female with a rather narrow hind lobe to the sternum, as is occasionally the case in *Cin. Pennsylvanicum*. I have seen such large numbers of *Cinosternum Pennsylvanicum*, that I feel little doubt upon this point" (p. 642). This is a very distinct and positive statement, apparently founded on actual observation; but let us now examine the confidence to be placed in it.

On turning to Professor Agassiz's account of *Cinosternoidæ* proper, I find he divides the North American species into—"1. *Thyrosternon Pennsylvanicum*, Agass.; the young are represented, pl. 4. f. 7, 12, and pl. 5. f. 16, 17. 2. *Thyrosternon Sonoriense*, Ag.; the young are represented, pl. 5. f. 11, under the name of *Cinosternon Sonoriense*, Le C. 3. *Thyrosternon integrum*, Ag. 4. *Platythyra flavescens*; they are represented, pl. 5. f. 12, 15." What was my astonishment, on referring to the plates, to find that the figures represented the three species I had

figured, and which we are informed, in the above note, are male and female of *Cinosternon Pennsylvanicum*; the "young female," which I am accused of making a species, being in his own work considered a distinct genus from the *Cinosternon* or *Thyrosternon Pennsylvanicum*!

If any one will take the trouble to compare the figures in the two works, I think they will have little doubt that the synonyma will stand thus:—

1. *Kinosternon Pennsylvanicum,* junior, Gray, Cat. t. 20 C. f. 1, 2, = *Thyrosternon Pennsylvanicum,* Agassiz, p. 428; *Cinosternum Pennsylvanicum,* pl. 4. f. 7, 12, pl. 5. f. 16, 17.
2. *Kinosternon Hippocrepis,* junior, Gray, Cat. t. 20 C. f. 3, 4, = *Platythyra flavescens,* Ag. p. 430; *Cinosternum flavescens,* Ag. pl. 5. f. 12, 15.
3. *Kinosternon punctatum,* junior, Gray, Cat. t. 20 C. f. 5, 6, = *Thyrosternon Sonoriense,* Ag. 428; *Cinosternum Sonoriense,* Ag. pl. 5. f. 8, 11.

I do not think it necessary to take any notice of the other observations in this brief communication, but shall refer to them in the Appendix to my Catalogue, which is in the press.

BIBLIOGRAPHICAL NOTICE.

Contributions to the Natural History of the United States of America. By Louis Agassiz. Vols. I. and II. 4to. Boston: Little, Brown & Co. London: Trübner & Co. 1857.

The first two volumes of Agassiz's 'Contributions to American Zoology,' so long announced, and so anxiously expected by his friends on both sides of the Atlantic, have at length made their appearance. They contain, first, an essay on general classification, forming an introduction to the whole work; and secondly, the results of the author's investigations on the *Testudinata,* to which he has devoted much time and toil during the last few years. This is divided into two parts, the first containing a special account of the North American members of the group, and the second an extended and laborious treatise on their embryology. The first portion of this book is of a nature so generally interesting to all who take pleasure in studying the laws and objects of creation,—it is so fairly and beautifully written, and gives a view of the subject so much more complete and philosophical than anything of the sort yet attempted, that it cannot but be regretted that it should be obtainable only in conjunction with the bulky work on a special subject, and which is, moreover, to be

extended to twelve volumes, to which it is attached; and we venture to recommend its re-issue in a separate form.

In the first chapter of this introductory essay, Professor Agassiz enters at length into the fundamental relations of animals to one another and to the world in which they live. He insists that "classification rests upon too narrow a foundation, when it is chiefly based on structure." "Animals," he most truly observes, "are linked together as closely by their mode of development, by their relative standing in their respective classes, by the order in which they have made their appearance upon earth, by their geographical distribution, and generally by their connexion with the world in which they live, as by their anatomy. All these relations should, therefore, be fully expressed in a natural classification; and, though structure furnishes the most direct indication of some of these relations, always appreciable under every circumstance, other considerations should not be neglected which may complete our insight into the general plan of creation." Prof. Agassiz's views on the geographical distribution of animals, on the permanency of specific peculiarities, and on the parallelism between the geological succession of animals and the embryonic growth of their living representatives, are particularly worthy of notice. An ardent supporter of the theory of the permanency of species, he most emphatically repudiates the 'Vestigiarians' and their views, concluding with the proposition, that "Beings do not exist in consequence of the continued agency of physical causes, but have made their appearance upon earth by the immediate intervention of the Creator."

The second chapter treats of the leading groups of the existing system of animals, and gives us the author's views on 'types,' 'classes,' 'orders,' 'families,' 'genera,' and 'species.' Professor Agassiz repudiates as 'pedantic' all the other divisions and subdivisions so often employed in Natural History, such as subfamilies, subgenera, and the like. *Branches* or *types*, he says, are characterized by the plan of their structure, *classes* by the manner in which that plan is executed, *orders* by the degrees of complication of their structure, *families* by their form as far as determined by structure, *genera* by the details of the execution in special parts, and *species* by the "relations of individuals to one another and to the world in which they live, as well as by the proportions of their parts, their ornamentation, &c." Yet he allows that "there are other natural divisions which must be acknowledged in a natural zoological system, but these are not to be traced so uniformly as the former; they are in reality only limitations of the other kinds of divisions." As to species, Professor Agassiz rejects the generally-received notion, that sexual connexion resulting in fertile offspring is a trustworthy evidence of specific identity, and enters into this question at some length. As is well known, the Professor is an ardent advocate of the cause of the 'Polygenists' against the 'Monogenists' in their respective theories of the origin of the human race,—holding that man was created in nations, and distributed over the face of the

earth in geographical regions and provinces, like other created beings; and he takes this opportunity of introducing the very weighty remark, that he cannot conceive "how moral philosophers, who urge the unity of the origin of Man as one of the fundamental principles of their religion, can at the same time justify the necessity which it involves of a sexual intercourse between the nearest blood-relations of that assumed first and unique human family." We may say, however, that though he enlarges much upon the characters of species, and goes fully into the methods of discovering them, we wait still for a perfect solution of the celebrated '*crux*' "*what IS a species*?," to which we find no satisfactory answer here given. There is, however, very much that is worthy of serious attention in this chapter concerning the true method of investigation; and were these or similar rules (if these rules are not right) established and followed, there would be less cause for the well-grounded complaint, that in almost every "characterization of genera, of families, of orders, of classes, of types," "characters of the same *kind* are introduced almost indiscriminately to distinguish all these groups."

The introductory essay concludes with a chapter on the principal systems of Zoology, in the first part of which Prof. Agassiz gives us his own views. Like other distinguished naturalists of the present day, he is disposed to return to the fourfold division of the great Cuvier, as modified by modern investigators, and considers the *Protozoa* [?] an unnatural combination of the most heterogeneous beings, "to be divided partly among plants and partly among animals, in the classes of Acephala, Worms and Crustacea." The RADIATES he divides into *Polypi*, *Acalephæ* and *Echinoderms*; the MOLLUSKS into *Acephala*, *Gasteropoda* and *Cephalopoda*; the ARTICULATA into Worms, Crustaceans and Insects. In the VERTEBRATES he maintains that the number and limits of the classes are not yet satisfactorily ascertained, but is inclined to separate them as follows into no less than *eight* (!) divisions:—

1. Myzontes (Myxinoids and Cyclostomes).
2. Fishes proper (Ctenoids and Cycloids).
3. Ganoids (Cœlacanths, Acipenseroids, Sauroids, and doubtful, Siluroids, Plectognaths and Leptobranches).
4. Selachians (Chimæræ, Galeodes and Batides).
5. Amphibians (Cæciliæ, Ichthyodi and Anura).
6. Reptiles (Serpentes, Saurii, Rhizodontes and Testudinata).
7. Birds (Natatores, Grallæ, Rasores and Insessores).
8. Mammals (Marsupialia, Herbivora and Carnivora).

It would not be difficult to pick holes in this portion of Professor Agassiz's arrangement, particularly as relates to the two latter classes, and the author himself submits his views "rather as suggestions for future researches than as matured results."

The second part of the work—" On North American Testudinata"

—is also highly worthy of the attention of naturalists in general, and affords Prof. Agassiz "a welcome opportunity of testing the principles of classification discussed in the first part."

Those who have paid special attention to the difficult order of Reptilia of which it treats, will be best able to judge whether the author has so carried out his principles of classification as to produce a more perfect arrangement of these animals than former writers on the same subject. But there can be no question as to the great additions made by this treatise to our knowledge of this class of beings, particularly as regards their embryonic condition and their progressive growth. The territory of the United States of America, much better provided with Reptiles and Amphibians of every Order than Europe, is particularly fortunate in the case of the *Testudinata*. In place of the few straggling species of Land-Turtles which appear in the southern parts of Europe, more than twenty land and fresh-water Tortoises have long since been recognized as inhabiting different parts of the North American continent; and, if Professor Agassiz's views are correct, their number must now be reckoned at thirty-seven —all occurring within the limits of the United States. Many of these species are very abundant, and several of them are a favourite article of diet in America. The 'Salt-water Terrapin,' *Malacoclemmys palustris* (which, we beg to suggest, might have been very appropriately named '*Euchylo-clemmys*'), is pre-eminent among these, and considered by many to be superior in flavour to true '*turtle*.' Those who have been so fortunate as to assist at one of the evening meetings of the Savants of Philadelphia called by the name of 'Whister-parties,' cannot fail to recollect the 'call' which there always is for the dish in which the limbs of this little animal are served up under the denomination of 'Stewed Terrapins.'

The abundance of these *Testudinata* in the United States, and the kindness of correspondents in different parts of the Union, enabled Professor Agassiz to make a very large collection of living examples, and gave him a great advantage over former observers in Europe, who have been obliged to draw their characters from dead specimens. "The number of living Turtles I have had an opportunity of examining and preserving for months and years in my yard," says the Professor, "will appear incredible to European naturalists: I have had them and their eggs by thousands;" and, again, "There are many species of which I have examined many hundreds of specimens." It is evident, therefore, that his advantages have been great; and the views of an observer so distinguished, and with such opportunities, must be entitled to no small respect.

Professor Agassiz divides the *Testudinata* into the two natural suborders, for which he adopts the names *Chelonii* and *Amydæ*, proposed by Oppel as long ago as 1811. Of the first, containing the Sea-Turtles, he makes two families, *Sphargididæ* and *Chelonioidæ*, according to a division which has been already recognized, if not generally employed. The second suborder, which contains the Land- and Freshwater-Turtles, he separates into seven families—*Triony-*

chidæ, *Chelyoidæ*, *Hydraspididæ*, *Chelydroidæ*, *Cinosternidæ*, *Emydoidæ*, and *Testudinina*.

After pointing out the distinctions between these groups, he enters at length into the characters and distribution of the species found in North America, which he makes about fifty in number. It is a remarkable fact, that of the Land and Freshwater division only one occurs on the Pacific slope of the continent (*Actinemys marmorata*), the so-called *Chrysemys oregonensis* being from the Upper Missouri, and not from Oregon.

A list of these animals, according to the generic and specific appellations adopted by Prof. Agassiz, we give below in a tabulated form, which will show at a glance the result of this part of his labours. With regard to the names employed, we have one or two observations to make. In respect to terms misspelt and wrongly derived, every thinking person must agree with Prof. Agassiz, whose well-known efforts to correct zoological nomenclature entitle him to especial attention on this subject. Far be it from us to defend such ungrammatical barbarisms as are involved in writing 'Trionycidæ' for 'Trionychidæ,' 'Kinosternon' for 'Cinosternon,' 'Malaclemys' for 'Malacoclemmys;' but we are not prepared to give up without protest the very convenient and now generally recognized practice of forming the names of families in *idæ* and subfamilies in *inæ*, which, though not strictly accurate, is an excellent *memoria technica*, and guides one at once to the rank of the division intended. Now that the divisions of organized beings are so numerous, some such scheme is absolutely requisite, to show whether a class, order, or family is intended by any particular designation. We may remark, also, that Professor Agassiz's arrangement would have been more intelligible to those who are engaged in working at this group, as well as more convenient for reference, if a short Synopsis of the American Testudinata, as now known, with scientific characters of the families, genera and species, and a more detailed list of synonyms, had been added. To one so well '*up*' in his subject as the author of this work, this would have given but little additional trouble. To those who are less favourably situated for acquiring a knowledge of these animals, it would have been of great service to enable them to see at a glance the reason of the many changes which Professor Agassiz has proposed in the arrangement and nomenclature of the families, genera and species.

In conclusion, we beg to congratulate Prof. Agassiz on his array of American subscribers, numbering some 2400 we believe,—an unheard-of amount of patronage to be bestowed on a purely scientific work, and which shows that the American people know how to appreciate a good man when they have got him. The European list presents a miserable contrast; and had it not been for the energy of Messrs. Trübner (who subscribe for 50 copies), this great work must have remained nearly unknown on this side of the Atlantic.

Table of North American Testudinata, according to the Arrangement of Prof. Agassiz.

a. SPHARGIDIDÆ.	I. Sphargis.........	1. coriacea, ex Oceano Atlant.
b. CHELONIOIDÆ.	I. Chelonia	1. mydas, ex Oceano Atlant.
		2. virgata, ex Oceano Pacif.
	II. Eretmochelys..	1. imbricata, ex Oceano Atlant.
		2. squamata, ex Oceano Pacif.
	III. Thalassochelys	1. caouana, ex Oceano Atlant.
c. TRIONYCHIDÆ.	I. Amyda	1. mutica, ex Nov. Eb., Pennsylv., Ind. &c.
	II. Platypeltis.....,	1. ferox, ex Georg., Louisian. &c.
	III. Aspidonectes...	1. spinifer, ex Stat. Bor., Or. et Occ.
		2. asper, ex Louisiana.
		3. nuchalis, ex Tennessee.
		4. Emoryi, ex Texas.
d. CHELYDROIDÆ.	I. Gypochelys ...	1. lacertina, ex Stat. Mer. Occ.
	II. Chelydra	1. serpentina, ex Stat. Orient. et Occ.
e. CINOSTERNIDÆ. Subfam. *Ozothecoidæ.*	1. Goniochelys	1. triquetra, ex Louisian.
		2. minor, ex Georgia.
	2. Ozotheca ...	1. odorata, ex Stat. Or. et Occ.
		2. tristycha, ex Stat. Mer. Occ.
Subfam. *Cinosternoidæ.*	3. Thyrosternon	1. pennsylvanicum, ex Stat. omn.
		2. sonoriense, ex Sonora.
		3. integrum, ex Mexico.
	4. Platythyra...	1. flavescens, ex Texas.
f. EMYDOIDÆ. I. Subfam. *Nectemydoidæ.*	I. Ptychemys	1. rugosa, ex Nov. Jers. et Virg.
		2. concinna, ex Stat. Mer.
		3. mobiliensis, ex Stat. Mer. et Texas.
		4. hieroglyphica, ex Georgia.
		5. decussata, ex Cuba.
	II. Trachemys ...	1. scabra, ex Car. Bor. et Georgia.
		2. Troostii, ex Stat. Occ.
		3. elegans, ex fl. Miss. sup. et Texas.
		4. rugosa, ex Cuba.
	III. Graptemys......	1. geographica, ex Stat. Or. et Mer.
		2. Lesueuri, ex Stat. Occ.
	IV. Malacoclemmys	1. palustris, ex Stat. Atlant.
	V. Chrysemys......	1. picta, ex Stat. Or. et med.
		2. marginata, ex Stat. Occ.
		3. Belli, ex Illin. et fl. Miss.
		4. oregonensis, ex fl. Miss. sup.
		5. dorsalis, ex Stat. Mer.
II. Subfam. *Deirochelyoidæ.*	VI. Deirochelys...	1. reticulata, ex Stat. Mer.
III. Subfam. *Euemydoidæ.*	VII. Emys	1. meleagris, ex Stat. Bor. et Occ.
IV. Subfam. *Clemmydoidæ.*	VIII. Nanemys......	1. guttata, ex Stat. Or.
	IX. Calemys	1. Muhlenbergii, ex Nov. Jers. et Pennsylv.
	X. Glyptemys ...	1. insculpta, ex Stat. Bor. Or.
	XI. Actinemys ...	1. marmorata, ex California.
V. Subfam. *Cistudinina.*	XII. Cistudo	1. virginea, ex Stat. Bor. Or.
		2. triunguis, ex Stat. Mer. Occ.
		3. ornata, ex Stat. Bor. Occ.
		4. major, ex Stat. Mer. Or.
g. TESTUDININA.	I. Xerobates	1. carolinus, ex Car. et Texas.
		2. Berlandieri, ex Tex. Mer. et Mex.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

November 24, 1857.—John Gould, Esq., F.R.S., V.P., in the Chair.

Observations on the genus Furcella, Oken, a Conchifer without concha or normal valves, and on the genera Teredo and Chæna. By John Edward Gray, Ph.D., F.R.S., V.P.Z.S. etc.

The shelly tube of this animal has been described under several names. Linnæus considered it as a *Serpula*; Pallas, Home, and more recently Messrs. Adams have regarded it as a *Teredo*. Oken (1815) considered it a genus under the name of *Furcella*, to which the following names have been given:—*Septaria*, Lamk., *Clossonaria*, Férussac, *Clausaria*, Menke, *Kuphus*, Gray, altered to *Kyphus* by Agassiz.

There is no doubt that it is allied to *Teredo*, and it has been separated from that genus by the older conchologists because the apex of the tube is solid and furnished with two separate tubular apertures, evidently for the siphons of the animal, which in some specimens are said to be produced beyond the end of the larger tube into two slender, elongated, cylindrical tubules, as figured by Rumphius; hence the name given to it by Oken: but I have never seen a specimen which exhibited this character.

The habit of the animal at once separates it from *Teredo*, which always lives in wood, while the *Furcella* lives sunk perpendicularly in the sandy mud of the tropical seas.

The external appearance of the shelly tube agrees with this habitat; for instead of being nearly cylindrical and more or less twisted according to the hardness or knots in the wood, it is club-shaped and closed at the larger end with a convex plate like the tube of *Chæna mumia*, which lives in the sand in a similar manner; but the tube of the *Furcella* is much larger, and generally rather distorted and irregular on the surface, divided into sections by more or less distinct constriction of its diameter or by the slight alteration in the direction of the tube, which on examination are evidently produced by the periodical stoppages in the growth of the animal, which at each period of suspended activity evidently closes up the end of the tube; the animal absorbs this terminal plate when it again returns to activity, and requires a larger tube for its increasing dimensions. In the specimen before me, the space between these interruptions in growth increased in length as the animal grew and enlarged in diameter.

The tube is thickened above as the animal leaves it, and is much thinner near the lower or closed extremity. The whole length of the tube is solid, without any perforations, except quite near the closed end, where it is pierced with a number of unequal-sized rather irregularly disposed small perforations, generally scattered; but sometimes there is a short series of five or six placed in a longitudinal

line, and these holes appear to be filled up by an internal coat when the animal absorbs the end and lengthens its tube.

The larger end of the tube is entirely closed over by two convex, arched, shelly laminæ, continuous from each side of the tube, and meeting and slightly overlapping one another in the central line, which is opposite to the septum between the two tubes in the smaller end of the shell-sheath of the animal.

These small holes are evidently intended for admission of water to the animal, and the shelly septa at the bottom to protect it from the sand in which it lives. The holes are similar to the tubes of *Penicillus aquarius* and *Clavagella,* which live in sand, and *Bryopa melitensis,* which lives in porous stone.

I have not observed any similar perforations in the tube of the *Teredo*; and indeed they would not be of any use, as the tube is deeply sunk in the substance of the wood in which the animal burrows.

The *Teredines* appear during their period of rest to close the end of their tube, with a shelly septum formed of a single convex plate. There are two fragments of tubes in the British Museum which appear to belong to that genus, from their external appearance and prismatic structure, which are so closed at the bases: in one specimen the closing septum is uniformly convex, and like the tube-structure; in the other the septum is divided into two equal portions by a transverse groove or depression; but on neither of the specimens can I observe any traces of the septum being formed of two plates overlapping in the middle like the septum of *Furcella.*

The calcareous tubes of *Septaria,* mentioned by Home, Phil. Trans. 1806, p. 276, Dillwyn, R. Shells, ii. p. 1088, and in the 'Mag. Nat. Hist.' 1838, p. 408, as having a succession of *septa,* proved on re-examination, Mr. Woodward informs me, to be the shells of *Vermeti.*

The character of the family *Teredinidæ* is, that the animal always lives in a tube; that it is provided with two appendages, one on each side of the siphons, called *palettes,* which differ considerably in structure in the different genera; and that the front of the body of the animal over the mouth is encased in two very small valves like those of a *Pholas* in structure and form, but in a more rudimentary state of development; the tubular case of the animal apparently taking the place, or being in fact a great development of the dorsal additional shelly plate usually found more or less developed in the different genera of *Pholadidæ.*

Now it is clear that by Pallas, Home, and Messrs. Adams referring this shelly tube to the genus *Teredo,* they believed that it had all these peculiarities.

I was, therefore, very much pleased when a perfect specimen of this interesting genus came into my hands yesterday, to think that I might have the opportunity of bringing before the Society the palette and valves of this genus, which until now have been desiderata, especially as the sound made by shaking the tube showed that some shelly pieces were contained within it.

But on making a small aperture on the side near the base of the tube to examine the structure of the valves, I was astonished to find

that, though the genus had two of the characteristics of the family of *Teredinidæ*, it wanted one of them; the plates within were only the *palettes*, which are simple and somewhat like those of the more common *Teredo norvegica*; there were no proper shelly valves, not even any rudiments of them; and that the animal forms a genus in that family which has the abnormality of wanting the true shelly valves so universal in the Conchifera.

This absence may be explained by the fact that the animal does not require them to protect its head and nervous centre, living as it does in a soft sandy mud; while they are required in *Teredo* and the allied genera which have to bore their way into hard wood or stone to form the hole that is to be lined with the shelly tube.

Sir Everard Home in his 'Lectures,' when describing the animal of *Teredo navalis* (ii. t. 81), refers this shell-tube to the genus *Teredo*, and gives a very good figure of the *palettes*, or as he called them, "operculum," of it (tab. 81. f. 4 & 5); but he was not aware of this absence of the shelly valve, for he figures what he considers the "boring shell of the same *Teredo*" (fig. 6): but what he has here taken for the "boring shell," or true valves of the animal, is evidently a fragment of the plates which close the end of the tube.

It may be supposed that, perhaps, the valves might be very small and have fallen out; but I think this is impossible, as the holes at the narrow part of the tube are very small, and filled up with fragments of shell and sand. The tube otherwise is quite closed, and the animal had evidently been eaten out by dipterous larvæ, as there were abundance of their pupa-skins in the cavity.

I may observe, that in the genus *Penicillus*, Brug. (*Aspergillum*, Lamk.), which also lives in sand, and has a fringe of tubes round the convex base of the tube, the shelly valves are immersed in the substance of the tube; but *Furcella* is the only genus of Conchifera I am acquainted with that is entirely destitute of true valves, like the Tunicata.

The possession of the two separate apertures at the upper extremity of the tube does not appear to be exclusively confined to this genus; for in the British Museum we have three specimens of tubes which belong to *Teredo norvegicus*, or to a species allied to it, procured at the same time, and probably from the same place, but without any habitat.

They all have a succession of transverse laminæ at the upper extremity of the tube. In No. 1 these plates are pierced with an oblong central hole for the passage of the siphons, as is the case with most specimens of *T. norvegicus*. No. 2 is similar, but there is a projection on one side of the perforation of the plates dividing the aperture on that side into two parts; and in No. 3, instead of having a single oblong aperture as in the other specimens, there are two subcircular ones separated by a central transverse septum as in *Furcella*, as if the imperfect rib in No. 2 was transformed into a shelly plate extending right across the aperture, and which must be deposited between the two siphons of the animal.

In general the tubes of *Teredo* are entirely imbedded in the wood, but sometimes, as in a specimen we have in the Museum from the mouth of the River Nunn, the apices of the tubes of the shell project as if they were produced by the animal as the shelly tube enlarged beneath; but I believe this arises from, and at least is partially, if not entirely, caused by the surface of the wood disintegrating and leaving the apices of the tubes exposed. In the same collection are a series of the tubes of a species of *Teredo*, from Van Diemen's Land, which are more or less covered with *Serpulæ* and *Vermeti*; I suspect these must be specimens which have been partially or entirely exposed by the rotting of the wood in which they were enclosed.

These specimens from Van Diemen's Land, so covered with *Serpulæ*, also exhibit another peculiarity: in one case two tubes are parallel to each other, and firmly united by the outer surface of one of their sides into one body, which induced me to believe that they might be *Serpulæ*, until I examined the structure of the shell and observed the simple contracted apex of the upper extremity.

In those genera of *Teredinidæ* which have a number of half-septa across the upper or smaller aperture of the tube, forming a kind of incompletely valvular structure on the sides of the siphons, or as in *Furcella*, where the space between the siphons is entirely closed up, leaving only a tube for the passage of the siphon on each side of the upper cavity, these septa and the solid calcareous matter forming the tubes must be deposited by the surface of the siphons themselves, as the canal of the univalve *Zoophagous Gasteropods* is deposited by the siphon of the mantle of these animals.

And as the *palettes* or *opercula*, as they have been erroneously called, of this family, are fixed on each side between the base of the two more or less elongated siphons, in all those genera which have a siphonal septum like *Furcella*, or lamina like *Teredo* at the apical end of the tube, these *palettes* are always enclosed in the tube, and cannot be exserted as they are sometimes represented.

The character of this genus must be thus amended:—

FURCELLA.

Animal without any true shelly valves; siphonal palettes distinct, large; apex dilated, transverse, spathulate, with a central midrib and an elongated slender cylindrical base.

Tube clavate, irregular, sometimes bent; apex with two tubular siphonal apertures separated by a broad, hard, shelly, longitudinal dissepiment; base pierced with small scattered perforations; end enclosed by two overlapping convex septa, arising from the sides and completely closing the ends.

These arched terminal plates appear to be absorbed before each period of activity, and the end is again closed with similar plates at each period of rest, after a sufficient elongation and enlargement of the tube for the protection of the enlarged animal. Living sunk in sandy mud on the shore in tropical climates.

The perfect specimens of *Chæna mumia* are covered with a thin

external coat (sometimes covered externally with particles of sand and Foraminifera, imbedded in its surface), which is only partially attached to the general substance of the tube by thin lines, concentric with the lines of growth, leaving the rest of the coat separated from the surface of the tube by a distinct hollow space.

In some specimens, as those in the British Museum from Mozambique, the attached part of the outer coat is in nearly concentric ring-like transverse lines round the tube, leaving a more or less complete hollow ring between each attached portion. In others, as that from the Philippines in the same collection, the attached portion of the outer coat is oblique and interlaced so as to leave only narrow, elongated, oblong, hollow tessellated interspaces on the surface, which are acute at each end.

I am not certain that these characters are permanent; but if so, one may be called *Chæna annulosa,* and the other *Chæna tessellata.* In the latter the outer coat is simple and smooth externally. In the specimen from the Philippines the tube is covered with a close coat of sand and a few Foraminifera, which are deeply imbedded in the substance of the thin outer coat, giving it a very peculiar appearance.

The shell of the newly hatched animal, which remains as a nucleus on the coat of the older shells, is smooth, uniformly convex, without any appearance of the anterior truncation or of the radiating ridges, which is so peculiar in the adult shells; and it seems also to have a straight lower edge without any appearance of the large ventral gape of the genus.

The cavity of the tube is contracted by an internal ring just above the hinder end of the shells, leaving an oblong central aperture of about half the diameter of the tube. This contraction is formed of several shelly plates with interspaces between them.

The animal has the power of repairing a fracture of the tube. There is a specimen in the Museum which had evidently been completely broken across about half its length, and the direction of the tube altered; the two portions have been united by an internal irregular white shelly coat.

December 8, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

On a New Species of Cassowary.
By John Gould, F.R.S., V.P., etc.

I think it has been shown, that not only many species, but whole genera, and even great families of birds, formerly existed on the surface of the globe, of which no living representatives now remain, but whose previous existence is made manifest to us by their foot-prints, the remains of their osseous structure, or portions of their egg-shells; some of these lived in periods of the most remote antiquity, while others are doubtless coeval with Man: of these latter probably not a few owe their extirpation to his wanton disregard for their perpetuity, such as the Dodo, the Dinornis, the Norfolk Island Parrot,

&c.; their extinction being aided by their large size rendering them conspicuous objects, and by the circumstance of their being denizens of very limited areas, of small groups of islands, such as Mauritius, Madagascar, Norfolk and Philip Islands, &c. The great group of extinct struthious birds with which Owen and the younger Mantell have made us so well acquainted, is one which all ornithologists must regard with especial interest, and this interest will I doubt not be greatly enhanced when I state that I have undoubted evidence that a species pertaining to it, and hitherto unknown to us, is still living on our globe. These few prefatory remarks are given before introducing to the notice of the Society a most interesting communication which I have just received from George Bennett, Esq., of Sydney, respecting a new species of Cassowary lately discovered in the Island of New Britain, an example of which, apparently fully adult, is either now living at Sydney, or *en route* to Europe: that it may soon arrive, or if it should unfortunately die, its skin may be duly preserved and sent to us, is my anxious hope. I am sure I need not expatiate upon the warm interest which our corresponding member, Dr. Bennett, has always manifested for the welfare of this Society, nor upon the value of the varied contributions he has made to natural science; it cannot fail to afford pleasure to us all to find, as will be seen, that this interest on his part is still undiminished. I think, therefore, that it will only be a just tribute of respect if we name the bird, of whose existence he has been the first to make us acquainted, Casuarius Bennetti.

Of this particular section of the *Struthionidæ*, then, there are the *C. galeatus*, a native of New Guinea, the *C. australis* inhabiting the Cape York district of Australia, and the *C. Bennetti*, whose domicile is the Island of New Britain.

The following are the details respecting this new species with which Mr. Bennett has favoured me:—

"Sydney, Sept. 10, 1857.

"My dear Gould,

"I send you an account of a new species of Cassowary recently brought to Sydney by Captain Devlin in the cutter 'Oberon;' it was procured from the natives of New Britain, an island in the South Pacific Ocean near to New Guinea, where it is known by the name of '*Mooruk*.' The height of the bird is 3 feet to the top of the back, and 5 feet when standing erect; its colour is rufous mixed with black on the back and hinder portions of the body, and raven-black about the neck and breast; the loose wavy skin of the neck is beautifully coloured with iridescent tints of bluish-purple, pink, and an occasional shade of green, quite different from the red and purple caruncles of the *Casuarius galeatus*; the feet and legs, which are very large and strong, are of a pale ash-colour, and exhibit a remarkable peculiarity in the extreme length of the claw of the inner toe on each foot, it being nearly three times the length which it obtains in the claws of the other toes; this bird also differs from the *C. galeatus* in having a horny plate instead of a helmet-like protuberance on the

top of the head, which callous plate has the character of and resembles mother of pearl darkened with black-lead; the form of the bill differs considerably from that of the Emu (*Dromaius Novæ-Hollandiæ*), being narrower, longer, and more curved, and in having a black and leathery cere at the base, and behind the plate of the head a small tuft of black hair-like feathers, which are continued in greater or lesser abundance over most parts of the neck.

"The bird is very tame and familiar, and when in a good humour frequently dances about its place of confinement. It is fed upon boiled potatoes and meat occasionally. The egg is about the same size as that of the Emu, and is of a dirty pale yellowish-green colour; I give this description from an egg obtained from the natives by Capt. Devlin.

"The bird appears to me to approximate more nearly to the Emu than to the Cassowary, and to form the link between those species. In its bearing and style of walking it resembles the former, throwing the head forward, and only becoming perfectly erect when running; it also very much resembles the Apteryx in the carriage of its body, in the style of its motion, and in its attitudes. It has been exhibited by Messrs. Wilcox and Turner in Hunter Street, Sydney.

"The accurate drawing which accompanies this letter was taken from life by Mr. G. F. Angas, whose correct delineation of objects of natural history is so well known; it conveys an excellent idea of the bird.

"Before closing my letter I have again examined the bird, and have to add, that its bill presents a good deal of the character of that of a Rail, and that it utters a peculiar whistling chirping sound; and I am informed that it also emits a loud one resembling the word 'Muruk,' whence no doubt is derived its native name. The existence of the species in New Britain or some of the neighbouring islands has been suspected for the last three years, and some time since a young specimen was procured, but unfortunately lost overboard during the voyage.

"Ever, my dear Gould,
"Your sincere friend,
"George Bennett."

As the bird has not yet reached this country, the fact of its being a new species must for the present rest upon Mr. Bennett's authority.

The account published by Mr. Wall of the discovery of the bird he has named *Casuarius australis* being but little known in this country, I have thought it might not be uninteresting to the meeting if I give a copy of it here as it appeared in the 'Illustrated Sydney Herald' of June 3, 1854:—

"The first specimen of this bird was procured by Mr. Thomas Wall, naturalist to the late expedition commanded by Mr. Kennedy. This was shot near Cape York, in one of those almost inaccessible gullies which abound in that part of the Australian continent. The Cassowary, when erect, stands about 5 feet high. The head is without feathers, but covered with a blue skin, and, like the Emu, is

almost without wings, having mere rudiments. The body is thickly covered with dark brown wiry feathers. On the head is a large protuberance or helmet of a bright red colour, and to the neck are attached, like bells, six or eight round fleshy balls of bright blue and scarlet, which give the bird a very beautiful appearance. The first, and indeed the only, specimen of the Australian Cassowary was unfortunately left at Weymouth Bay, and has not been recovered. Mr. Wall being most anxious for its preservation had secured it in a canvas bag and carried it with him to the spot where, unfortunately for himself and for science, it was lost. In the ravine where the bird was killed, as well as other deep and stony valleys of that neighbourhood, they were seen running in companies of seven or eight. On that part of the north-eastern coast, therefore, they are probably plentiful, and will be met with in all the deep gullies at the base of high hills. The flesh of this bird was eaten, and was found to be delicious; a single leg afforded more substantial food than ten or twelve hungry men could dispose of at one meal. The Cassowary possesses great strength in its legs, and makes use of this strength in the same manner as the Emu. Their whole build is, however, more strong and heavy than that of the latter bird. They are very wary, but their presence may be easily detected by their utterance of a peculiarly loud note, which is taken up and echoed along the gullies; and it would be easy to kill them with a rifle."

The above account was furnished to the 'Illustrated Sydney Herald' by Mr. Wall's brother, Mr. William Sheridan Wall, Curator of the Australian Museum.

No skin of this species having yet been sent home, I am unable to say if the bird be really a new species, or identical with the New Guinea bird, *Casuarius galeatus*. I trust, however, that the time is not far distant when some expedition more fortunate than the one to which Mr. Wall was attached may procure examples, and by making us better acquainted with the bird, enable us to decide this point.

Description of Eleven New Species of Birds from Tropical America. By Philip Lutley Sclater.

1. Campylorhynchus pardus.

Supra albo nigroque tessellatus, alis nigris albo regulariter transvittatis: cauda nigra, rectricibus maculis magnis albis in utroque pogonio crebro transfasciatis: nucha brunnea: pileo griseo, nigro punctato: superciliis et capitis lateribus albis, striga postoculari et rictali utrinque nigricantibus: subtus albus, gutture concolore, pectore, ventris lateribus et crisso maculis parvis rotundis notatis: tectricibus subalaribus albis; rostro breviore, debiliore, pallido, culmine corneo: pedibus nigris.

Long. tota 6·8, alæ 3·0, caudæ 3·0, rostri a rictu ·9.

Hab. In Nova Grenada in vicin. urbis S. Marthæ.

Mus. Brit.

This bird most nearly resembles *Camp. nuchalis* of Cabanis, or at

least a member of this difficult group from Trinidad, which in my collection bears that name. In their upper surfaces these two species are not unlike, although the head is paler, the nape more brown, and both the inner and outer webs of the tail-feathers are banded in the present bird, which is not the case in the former. But below, *C. pardus* is readily recognized by its pure white colour, varied sparingly with round black spots on the breast, sides of the belly and vent. My type-specimen was received from S. Martha by Mr. Lawrence of New York, who kindly entrusted it to me for examination. I have called it "*pardus*" because it is the bird so named (but not described) by Prince Bonaparte in his Ornithological Notes upon Delattre's collections (page 43). The specimen there alluded to, which was received by MM. Verreaux of Paris from S. Martha, is now in the British Museum. It is apparently a younger bird than my type, but easily recognizable as of the same species.

2. Campylorhynchus striaticollis.

Nigricanti-griseus; uropygium versus magis rufescens, pennis obsolete nigro marmoratis: alis caudaque nigricantibus, marginibus externis nigro et rufo anguste variegatis: subtus albo-griseus, gula albicante; cervice et pectore nigricante longitudinaliter striatis, ventre medio maculis rotundis obsoletis notato: ventre imo crissoque rufescentibus, nigro obsolete transvittatis: rostri pallide cornei culmine nigro; pedibus nigris.

Long. tota 6·5, alæ 3·1, caudæ 2·7, rostri a rictu 1·0.

Hab. In Nova Grenada.

This is a typical *Campylorhynchus*, of which I have met with only one example, now in my own collection, selected from amongst a large number of Bogota birds. It does not seem very like any of the fourteen species of the genus which I have enumerated in the 'Proceedings of the Academy of Nat. Sciences of Philadelphia' (1846, p. 264). The upper surface is nearly uniform, being only obsoletely marbled, an appearance caused by the centres of the feathers being darker. The fore-neck is longitudinally striated and not spotted, as is more usual among these birds; but there are round spots, not however very strongly marked, on the belly.

3. Anabazenops guttulatus.

Olivaceus, superciliis ab oculo in nucham productis rufis: pilei pennis medialiter olivaceis, nigricante marginatis; interscapulii pennis medialiter pallide ochraceis, nigricanti-ochraceo utrinque limbatis, et quasi illo colore guttatis: alis intus nigricantibus, extus brunnescentibus: cauda unicolore ferruginea; subtus gula albida, pectoris et ventris superioris plumis ochracescenti-albidis fulvo tinctis, marginibus fusco-olivascente circumdatis: lateribus et ventre imo terricolori-brunneis; crisso rufo: rostri cornei apice et basi flavidis; pedibus flavido-fuscis.

Long. tota 7·0, alæ 3·3, caudæ 3·0.

Hab. In Venezuela, prope urbem Caracas (*Levraud*).

Mus. Paris.

4. Synallaxis multo-striata.

Supra terricolori-brunnea, fronte et pileo antico rufis nigro variis : dorsi totius pennarum scapis flavo-albidis, strias longas formantibus : cauda, e rectricibus duodecim, nigricante, brunneo marginata, subtus pallide brunnea : corpore subtus terricolori-brunneo, albo confertim vario, plumis medialiter albis, nigrescenti-brunneo irregulariter circumcinctis ; gula pure rufa : rostro nigro, pedibus fusco-nigris.

Long. tota 6·5, alæ 2·4, caudæ 2·8.

Hab. In Nova Grenada.

Mus. Paris.

A specimen of this apparently new *Synallaxis* is in the Gallery of the Jardin des Plantes at Paris. It is marked "Bogota, Rieffer, 1843." It does not very closely resemble any species with which I am acquainted, and is rather remarkable as being striated both above and below.

5. Turdus fulviventris, Verreaux, MS.

Nigricanti-cinereus, alis caudaque obscurioribus ; capite toto cum gutture nigris ; cervice antica fuscescenti-cinerea : abdomine toto cum tectricibus subalaribus saturate cinnamomeo-rufis : crisso fusco : rostro flavo, pedibus pallide brunneis.

Long. tota 10·5, alæ 4·8, caudæ 4·0.

Hab. In Nova Grenada (Bogota).

Mus. Acad. Philadelph. et P. L. S.

I have received a single example of this fine Thrush from MM. Verreaux, with the MS. name attached, which I have adopted. It is quite distinct from every other bird of the group hitherto described, but may be placed near *Turdus migratorius* of the U. S.

6. Turdus ignobilis.

Cinerascenti-fuscus unicolor, subtus dilutior, gula albicante, striis paucis cinereis : abdomine medio cum crisso albis, lateribus cinerascentibus : tectricibus subalaribus fusco-cinereis, rufo vix tinctis : rostro corneo, pedibus fusco-nigris.

Long. tota 9·0, alæ 4·5, caudæ 3·9.

Hab. In Nova Grenada.

Mus. Acad. Philadelph. et P. L. S.

I have had examples of this Thrush some time in my possession, and have indicated it without naming it in my first list of birds from Bogota (P. Z. S. 1855, p. 145, sp. 168). Having lately obtained other specimens, I have no hesitation in describing it as apparently unnamed, unless indeed it chance to be Prince Bonaparte's *Turdus luridus* (Notes Orn. p. 28), which however it is impossible to determine from so brief a notice. In its uniform style of colouring it resembles *Turdus fumigatus* of Brazil and *T. Grayi* of Mexico, but may be immediately distinguished by the colour of the under wing-coverts, which are cinereous like the breast, with a faint tinge only of rufous. There are two examples of this same bird in the collec-

tion of the Academy of Natural Sciences of Philadelphia, also labelled "Bogota."

7. Cinclus leuconotus.

"*Cinclus leucocephalus,* Tsch." ; Lafr. Rev. Zool. 1847, p. 68.

Niger: pileo cum nucha, dorso medio et corpore subtus ad imum ventrem albis: crisso et hypochondriis nigris: pileo nigro striolato: rostro nigro, pedibus corneis.

Long. tota 5·5, alæ 3·8, caudæ 1·6, rostri a fronte ·6.

♀ (?). *Mari similis sed minor, rostro breviore.*

Long. tota 5·0, alæ 3·1, caudæ 1·5, rostri a fronte ·4.

Hab. In Nova Grenada et rep. Equatoriana.

Mus. Paris., Gul. Jardine Baronetti, et P. L. S.

This species is not the *Cinclus leucocephalus* of Tschudi, as I ascertained this summer by taking my specimens to Neufchatel and there comparing them with the type. Tschudi's bird is much larger and has the white below confined to the breast, and no white back. It is in short quite a different bird. The most peculiar thing however about my two specimens is, that one is larger than the other, and has the bill strikingly longer. After some hesitation I have attributed this to sex, though I am not aware of a similar difference occurring in the bills of other *Cincli.* I may remark, however, that though this bird is seemingly much like *Cinclus* in form, I cannot help thinking that, when we know more about it, we may find occasion to refer it to a different genus. My examples were picked out of a large number of ordinary Bogota skins, of which they have the usual unmistakeable appearance. The bird described by Lafresnaye was brought from Pasto by Delattre, and a specimen in the Paris Museum—marked *Cinclus leucocephalus*—is said to be from the vicinity of Quito. Sir William Jardine possesses examples from the same locality.

8. Tyrannus atrifrons.

T. supra pallide cineraceo-brunneus; vitta frontali inter oculos nigra, crista pilei medii celata aurea: alis nigricanti-brunneis, extus rufo late marginatis: tectricibus caudæ superioribus cum cauda tota rufis, rectricum (precipue mediarum) parte media nigricante: subtus flavus; gula albicante, pectore rufo paulum mixto, tectricibus alarum inferioribus pallide flavis, remigum pogoniis internis subtus ochraceis: rostro et pedibus nigris.

Long. tota 8·2, alæ 4·6, caudæ 3·75.

Hab. In littoribus reipub. Equatorianæ.

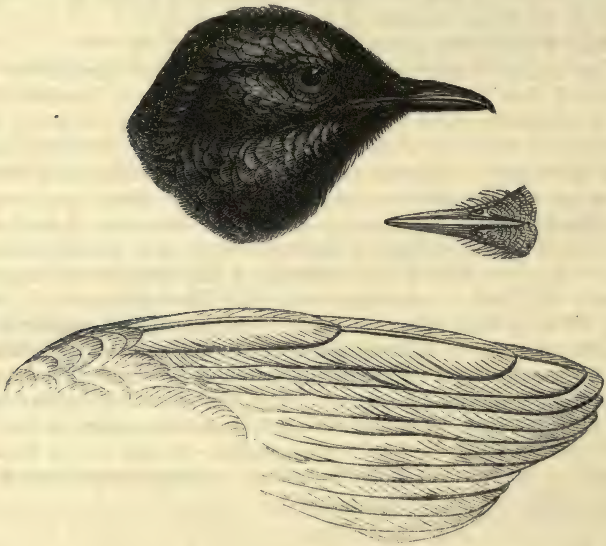
Mus. Brit. et T. C. Eyton.

Mr. Eyton's collection contains the type-specimen of this very well-marked species of Tyrant, which I believe to have been hitherto overlooked. It is labelled "Guyaquil," and that is no doubt its right locality, for two examples of the same bird in the British Mu-

seum were obtained on the island of Puna in the gulf of Guyaquil by Mr. Barclay.

MELANOPTILA, gen. nov.

Melanoptila, *genus novum e familia* TURDIDARUM. *Rostrum rectum, modicæ longitudinis, fere ut in genere* Turdo, *sed tenuius et vibrissis rictalibus nullis : alæ breves, ad finem subcaudalium attingentes, remige prima brevi, secunda secundarias co-æquante, tertia longiore, sed a quarta, quinta, et sexta, æqualibus et longissimis, superata : cauda longa, apice rotundata : pedes antice scutellatæ prout in genere* Turdo.



9. M. GLABRIROSTRIS.

M. nigra unicolor, cæruleo-nitens : alis caudaque æneo magis splendentibus : rostro et pedibus nigris.

Long. tota 7·8, alæ 3·5, caudæ 3·3, tarsi 1·05.

Hab. In rep. Honduras, prope urbem Omoa.

I first observed specimens of this curious bird in the Derby Museum at Liverpool. They were procured in Honduras by Delattre, and an excellent example from the same source is in the British Museum. A single specimen in my own collection was obtained, with other birds, by Mr. Joseph Leyland in the vicinity of Omoa at the extremity of the Bay of Honduras. I know of no other American form which much resembles it in plumage or in structure, and am rather puzzled as to its proper arrangement in the Natural System. It must however, I think, come within the limits of the

family *Turdidæ*, and for the present I am rather inclined to place it along with the Mock-birds (*Miminæ*), with the general structure of some of which it seems most nearly to accord, except in the absolute want of any signs of rictal bristles, whence I have called it *glabrirostris*.

Mr. Leyland informs me, with regard to this bird at Omoa, that he believes it is rare there, as he only saw one other individual during his stay. It frequents the low thick bushes.

Further information concerning the difference of the sexes, habits and internal structure of this interesting bird are requisite, before its true position can be satisfactorily established.

10. Lipaugus rufescens.

Rufescenti-brunneus, subtus clarior, capite et pectore subtilissime nigro, vittas obsoletas formante, transfasciatis: pennarum maculis apicalibus rotundis in pectore et ventre medio et in crisso sparsis, nigris: remigibus nigricantibus intus et extus rufo marginatis: alarum tectricibus superioribus rufis nigro variegatis, inferioribus rufis, fascia axillari crocea: cauda unicolore, rufescenti-brunnea: gula et crisso pure rufis: rostro nigricante, pedibus fuscis.

Long. tota 5·7, alæ 4·4, caudæ 3·3.

Hab. In rep. Guatimalensi prope urbem Coban (*Delattre*).

Mus. Britannico et Derbiano.

I examined an example of this bird with much care during an inspection of some of the riches of the Derby Museum at Liverpool, two years ago, and attached to it the MS. name which I now publish. Through the kindness of Mr. Thomas Moore I have lately had the opportunity of studying it a second time. Mr. G. R. Gray has obligingly pointed out to me a stuffed specimen in the British Museum, which is evidently the adult of this species, that in the Derby Museum being in an immature state; and I have therefore modified my original description, so as to render it applicable to the more perfect bird. In the younger stage the marking on the wings is not so decided, and the characteristic black spots on the breast, belly and crissum, and the axillary tufts, are absent. The specimen in the British Museum was procured from MM. Verreaux, and is labeled with the MS. name "*Lathriosoma typicum*, Bp." It is not however necessary to create a new generic name for this bird, as it certainly cannot be separated from *Lipaugus hypopyrrhus* (Vieill.), for which the term *Aulea* * (taken from Dr. Schiff's MS.) has been already published by Prince Bonaparte. It forms, in fact, an excellent second species of this division, which seems to serve as a connecting link between the genera *Lipaugus* and *Heteropelma*, and is perhaps worthy of generic rank.

11. Tinamus castaneus.

Saturate castaneus, capite et cervice undique cum gula nigri-

* Prince Bonaparte writes this word '*Aulea*,' but if, as I suppose is the case, it comes from *αὐλὸς*, *tibia*, the proper adjectival form would be *aulius*.

canti-cinereis, pileo nigricantiore, gula magis cinerascente: alarum pennis nigricantibus, tectricum et secundariarum marginibus externis dorso concoloribus: ventre imo cum cauda (tectricibus supra-caudalibus omnino abscondita) nigro et cervino flammulatis: rostri mandibula superiore nigricante, hujus autem tomiis cum mandibula inferiore flavidis: pedibus carneis.

Long. tota 8·5, alæ 5·5, caudæ 1·3, rostri a rictu 1·1, tarsi 1·9.

Hab. In Nov. Grenada interiore (Bogota).

Mus. P. L. S.

I obtained a single specimen of this Tinamou out of a large collection of Bogota skins in the hands of a dealer. I have in vain attempted to find a name for it, and have looked through the examples of these birds in the great Museums of Leyden, Paris and Philadelphia without finding a similar one. In the British Museum, however, is a specimen possibly referable to the young stage of this species.

The present bird agrees in size and shape tolerably well with *T. parvirostris* and *T. tataupa*, but is quite different in colouring from any member of the group with which I am acquainted.

ROYAL SOCIETY.

January 14, 1858.—The Lord Wrottesley, President, in the Chair.

"On the Electrical Nature of the Power possessed by the *Actiniæ* of our Shores." By Robert M'Donnell, M.D., M.R.I.A.

After referring to the well-known phænomena manifested by electrical fishes, and to alleged instances of numbing effects, but of doubtful electrical nature, produced on the naked hand by the contact of certain marine Invertebrata, the author describes his own observations and experiments with the Actinia as follows:—

Suppose that into a vessel containing some Actiniæ well expanded, and apparently on the look-out for food, some of the tadpoles of the common frog be introduced, these little creatures do not, like many freshwater fishes of about the same dimensions, immediately die; on the contrary, the salt water seems to stimulate their activity, they become very lively and swim about with vivacity. One of them may not unfrequently be observed to make its way among the tentacles of an Actinia and get off again quite uninjured; it may even for a time nestle among the tentacles with as much impunity as if it were only in contact with a piece of sea-weed; but should the tadpole have the misfortune to fall in with a more voracious Actinia, the reception it meets with is very different. Sometimes, when by an incautious lash of its tail it touches even a single tentacle, it may at once be laid hold of, and in the violent efforts which it forthwith makes to break loose, often merely brings itself within the reach of other tentacles, by which it is seized and overpowered. Occasionally, however, after having been thus seized, the tadpole by its superior activity succeeds in effecting its escape, and when it does so, it seems for a time singularly excited; it twists and writhes and wriggles through the

water, so as to leave no doubt that some very remarkable influence has been exerted upon it.

These observations are no doubt familiar to all who have studied the habits of these animals; for although the tadpole seems more susceptible of the peculiar stimulus which the Actinia can communicate than most of those creatures which are ordinarily cast in its way, yet the same occurrences take place with the small crustaceans, &c. which are abundant in sea-water. Indeed no very close attention is necessary to perceive, that while on some occasions these little animals may creep to and fro over the surface and among the tentacles of the Actinia, at other times they are seized and killed with the greatest promptitude.

It remained to be determined what is the exact nature of the power which the Actinia has been thus found to have under its control. If it seized its victim by a simple mechanical effort, why should the tadpole be so agitated for some time after having escaped from its grasp? No peculiarly viscid secretion could be detected on the tentacles, nor could any decided reaction be discerned on their surface differing from the feebly alkaline condition of the sea-water in which they were placed; moreover, the power of the Actinia seemed often to be exerted with too much promptness to be compatible with the notion of the formation of a poisonous or stinging fluid over its surface.

On the hypothesis that it is an electrical power with which the Actiniæ are endowed, it is obvious that the existence of animal electricity in them ought to be experimentally demonstrable by its physiological effects, inasmuch as these phænomena are the most striking which animal electricity is capable of producing in common with other electricities derived from different sources.

The following experiments, in which the frog's limb was used as a galvanometer (the limb of this animal being, as is well known, an instrument of extreme delicacy for this purpose), seem satisfactorily to establish the fact that the common Actiniæ of our shores are gifted with electrical power.

1st. Having prepared the lower limb of a lively frog after the mode described by Matteucci, by stripping off the skin, dissecting out the sciatic nerve from among the muscles of the thigh, and then cutting off the thigh a little above the knee, so as to leave the nerve uninjured and as long as possible, the limb was laid on a small piece of glass, so that the nerve hung down over its edge. The pendent nerve was lowered into the water and gently brought in contact with the tentacles of an expanded Actinia. From the first or the second, or even several, possibly no effect may result, but arriving at last at one more vigorous than his neighbours, smart muscular contractions follow as he grasps the nerve in his tentacles, and the toes are thrown into active movement.

2nd. The next experiment, although of precisely the same nature as that first detailed, renders the effect produced on the muscles of the frog's limb more striking. A large and lively frog is killed, the skin is stripped off, and the viscera being removed, the body is cut

off about the middle; a knife being slipped behind the lumbar plexus of nerves, the pelvic bones and contiguous soft parts are cut away, so that the lumbar vertebræ remain connected with the lower extremities merely by the nervous cords passing to each limb. Thus prepared, the limbs are laid on a thin piece of board, so that the vertebræ hang over its edge dangling by the undivided nerves. The piece of board is placed floating on the surface of the water in which are the Actiniæ, and is slowly pushed over within reach of an active one. Immediately that the Actinia seizes the morsel thus offered to it, contractions are observed to commence in the thigh, extend to the calf, and soon the toes are in movement.

3rd. In order to set aside the supposition that these muscular contractions might be the result of chemical or mechanical irritation applied to the extremities of the nerves, it became necessary to devise a modification of the foregoing experiments; for although irritants, such as turpentine, croton oil, ammonia, friction with a nettle leaf, &c., were applied to the nerves without producing any effect like that obtained from the Actiniæ, it seemed still possible that the contractions might be due to some other agent than electricity.

The following experiment seems to remove all doubt. A piece of copper wire, a few inches long, was coated with sealing-wax, except about half an inch at each end; the ends were rubbed clean with sand-paper, one of them was thrust into the lower part of the spinal canal of a frog prepared as in the last experiment, while the other, which was to be offered to an Actinia, was passed into a portion of the frog's intestine put on like a glove; for the Actinia does not seize vigorously metallic substances. The limbs of the frog with the nerves and vertebræ attached, are laid on a piece of board, while the copper wire, which is curved, arches over the edge of it; so that the end covered with frog's intestine can be readily brought within the reach of the Actinia. Having waited for a few minutes until the muscular contractions excited by thrusting the wire into the spinal canal have ceased (and they are in general very transient), the board is placed floating on the water, and the frog's intestine offered to an Actinia; muscular contractions ensue, perhaps not so promptly, certainly not so vigorously as in the former experiments, but nevertheless easily to be recognized and unmistakeable. They commence in the thighs, and, as in the former case, extend to the calves, and then the toes move actively. This last experiment has been modified in a variety of ways, but the same result has been constantly obtained. Perhaps the best modification of it is to use a piece of copper wire having one end coiled so as to form a disk which is covered with chamois-leather, while the other is sharp-pointed to enter the spinal canal of the frog. The whole, except the surface of the disk, which is to be given to the Actinia, and the point for the spinal canal, is covered with sealing-wax, and the frog's limbs extended upon a thin piece of board. With this arrangement precisely the same effects were produced as already described.

It is a remarkable fact, and deserves special notice, that in all these experiments the muscular contractions, when once strongly

excited, whether by direct contact or through the medium of wire, do *not* at once subside. When the limbs are withdrawn from the influence of the Actinia in the first experiments, or removed from the wire in the last, strong muscular contractions continue to take place for from three to five minutes.

All the varieties of Actinia which have hitherto been made the subject of experiment, have given similar evidence of electrical power, but by no means in an equal degree. The large varieties are found, in proportion to their size, much feebler than those of less dimensions, and any attempt to succeed in the experiment with the copper wire has failed with them.

A somewhat similar observation has been made by Dr. John Davy regarding the Torpedo, for he tells us (Philosophical Transactions, 1834, p. 548) that he has seen strong vivacious fish which made great muscular exertions in the water, almost or entirely destitute of electrical action.

It is obvious that in creatures of such moderate dimensions as Actiniæ, of so peculiar a form and of such feeble power, much difficulty is to be expected in demonstrating the other experimental effects which animal electricity is capable of producing in common with other electricities, viz. magnetic deflection,—magnetising of needles,—spark,—heating power, and chemical action ; and it must be admitted that all experiments hitherto undertaken on this subject have been attended with negative results. I hope, and indeed expect, when further opportunities are afforded of examining these creatures in health and vigour in their native pools, to obtain more satisfactory results on these points, when I shall look forward to the pleasure of making a further communication on the subject.

February 4, 1858.—The Lord Wrottesley, President, in the Chair.

"Researches on the Poison-apparatus in the *Actiniadæ*." By Philip Henry Gosse, Esq., F.R.S.

The organs which have been termed "thread-cells," "thread-capsules," "urticating organs," "lasso-cells," &c., I propose to call *cnidæ*. They are found in various tissues of the body, but are specially localized in two sets of organs, which I call *craspeda* and *acontia*. The *craspeda* are gelatinous cords connected throughout their length with the free edges of the muscular septa. The *acontia* are somewhat similar cords, but free throughout, except at their base, where they are inserted into the septa. The cord-like appearance of these latter organs is, however, illusory, as each is a narrow ribbon with involute margins. Both the *craspeda* and the *acontia* are composed of a clear plasma, in which many *cnidæ* are crowded.

The *craspeda* appear to be universally possessed by this tribe of animals, but the *acontia* are limited to a few genera, principally *Sagartia* and *Adamsia*. They are ejected from the body of the animal, and are again withdrawn.

For the emission of these organs special orifices exist, which I term *cinclides*. These are minute perforations of the muscular

coats and the integument, bearing a resemblance in appearance to the spiracles of insects. Being placed in the interseptal spaces, they have a perpendicular arrangement, but are not regularly disposed in any other respect. They can be opened widely, or perfectly closed at the will of the animal; and are well seen, under a low power of the microscope, when a *Sagartia bellis* or *dianthus* is much distended in a parallel-sided glass vessel, with a strong light behind it. The width of these orifices varies from $\frac{1}{300}$th to $\frac{1}{50}$th of an inch. No ciliary current passes through them.

Under irritation the *Sagartia* forcibly and repeatedly contracts its body, forcing out the water which had distended its aquiferous canals and the general cavity of the body. Much of the fluid finds vent at these foramina, carrying with it the free floating part of some or other of the numerous *acontia*, each through that *cinclis* which happens to lie nearest to it. The frequency with which the *acontia* escape in a *loop* or *bight*, shows that the issue is the result of a merely mechanical action, viz. that of the escaping water.

The *cnidæ* occur under four distinct forms. 1. Chambered cnidæ (*Cnidæ cameratæ*). This is the most widely distributed, and the most elaborately armed. In *Cyathina Smithii* they occur of comparatively large size, and are therefore well suited for observation. They are transparent, colourless vesicles, of a long, oval figure, $\frac{1}{260}$th of an inch in length, and $\frac{1}{2000}$th in diameter. A fusiform chamber passes through the centre of the anterior moiety, merging at one extremity into the walls of the *cnida*, and at the other diminishing to a slender chord, which is irregularly coiled within the general cavity.

Under stimulus the *cnidæ* suddenly expel their contents with great force. In general the eye can scarcely follow the excessive rapidity with which the chamber and its twining thread are shot forth. When fully expelled, the thread, which I distinguish by the term *ecthoræum*, is often thirty times as long as the *cnida*; but in *Sagartia* generally, it frequently is not more than once and a half the length of the *cnida*.

In the *ecthoræum* from *chambered cnidæ* the basal portion is distinctly swollen; thence, becoming attenuated, it runs on as an excessively slender wire of equal diameter. Around this basal part wind one or more spiral thickened bands, varying, in different species, as to their number, the number of volutions made by each, and the angle which the spiral forms with the axis. The direction is from east to north. The spiral armature I call the screw, or *strebla*. There is no other form of armature than this.

These thickened spiral bands afford insertion to a series of fine *setæ*, which I call *pterygia*. These are from eight to twelve in a single volution, and they project in a diagonal direction from the *ecthoræum*, but often become reverted. In some cases, perhaps in all, the *strebla* and the *pterygia* are continued beyond the swollen portion of the *ecthoræum*, even to the end of the attenuated part.

2. Tangled cnidæ (*Cnidæ glomiferæ*). This sort differs from the preceding chiefly in the uniform slenderness of the *ecthoræum*, which lies coiled up more or less regularly in the *cnida*, without any

chamber. *Corynactis viridis* affords excellent examples for observation.

3. Spiral cnidæ (*Cnidæ cochleatæ*). The walls of the tentacles, in a few species, contain very elongated fusiform *cnidæ*, which seem composed of a slender thread coiled up in a very close and regular spiral, bearing a resemblance to the shell of a *Cerithium*. The *ecthoræum* is discharged reluctantly, and the wall of the *cnida* is very subtile.

4. Globate cnidæ (*Cnidæ globatæ*)? These are globose vesicles found in the *acontium* of *S. parasitica*, which have some characters in common with the *cnidæ*, but of whose real nature I am doubtful.

In the indubitable *cnidæ* the emission of the *ecthoræum* is a process of eversion. This is proved by many circumstances, such as the order in which the portions are evolved, the basal portion first; as well as by direct observation, the terminal part of the *ecthoræum* being occasionally detected in running out through the centre of the portion already evolved.

The *cnidæ* are filled with a fluid, which holds organic corpuscles in suspension, and these are seen driven rapidly through the *ecthoræum* in the process of eversion. I conclude that in this fluid resides the expansile force, which, on the excitement of a suitable stimulus, distends and projects the tubular portion of the wall that has hitherto been inverted.

All of the four kinds of *cnidæ* enumerated have been at various times seen surrounded by a membranous investiture, which I distinguish as the *peribola*. This coat must be ruptured before the *cnida* can emit the *ecthoræum*.

Several experiments show that the *ecthoræum* has the power of penetrating the tissues of other creatures and even of the Vertebrata. In some of these experiments shavings of human cuticle, presented for an instant to the tentacles of *Bunodes crassicornis*, and to the *acontium* of *S. parasitica*, were found on examination to be pierced through with numerous *cnidæ*.

Experiments with blue vegetable juices were instituted, with a view to test the acid or alkaline properties of the poisonous fluid supposed to be ejected on the discharge of the *ecthoræum*; but with no definite result. The existence of such a poisonous fluid is inferred, however, with a degree of probability amounting to moral certainty, and that of such concentrated power as, under certain circumstances, to destroy life with great rapidity, even in vertebrate animals.

Admitting the existence of a venomous fluid, it is difficult to determine where it is lodged, and how it is injected. I incline to the hypothesis, that the cavity of the *ecthoræum* in its primal inverted condition, while it yet remains coiled up in the *cnida*, is occupied with the poisonous fluid, and that it is poured out gradually, within the tissues of the victim, as the evolving tip of the wire penetrates farther and farther into the wound.

MISCELLANEOUS.

Remarks on the Habits of the Common Mussel. By David Robertson, Esq.

I have been much interested in watching the habits of a common Mussel (*Mytilus edulis*), which has afforded me many hours of pleasant amusement. It had been in my keeping for three months. I had taken little notice of it, till finding that it had removed from the bottom, and attached itself about two inches up the side of the jar, I became curious to know how it had got up. I observed that the fibres of the byssus were fixed at various heights; that the lowermost were fully an inch from the bottom; that by their apparent contraction it could raise itself nearly an inch; and that from this position other fibres could and had been fixed higher up; hence the ascent. It remained in this position for eight days, during that time adding more fibres till it had twenty-one, the lowermost now appearing circularly below the shell, and the upper ones circularly above it. It was now apparently a permanent fixture, at least within the limits of its moorings; by drawing the byssus towards the beak, or the base, it could move the ends of the shell alternately up and down: the movements were at times frequent. On the tenth day after mounting the side of the jar, it detached itself, and fixed upon another place a little farther round, by four new fibres, leaving the old byssus hanging to the glass; this is an interesting microscopic object, somewhat palmate, dividing into numerous filaments, and is attached to the animal by a small peduncle, which nature has given the creature power to sever when a change is required. I was desirous to see the actual process of fixing the fibres, and began to watch with more care. It had now six fibres; and, with the hope that it would require to produce more, I cut three, leaving only three, by which it supported itself and went through its usual movements with apparent ease; the only perceptible effect was a slight jerk down at the severance of each fibre. The fewness and fineness of the filaments, and the delicacy of their attachment, looked very inadequate for the suspension of the animal; but they proved to be strong enough and something to spare, as one of its neighbours, the Hermit Crab (*Pagurus Bernhardus*), mounted occasionally on the top of the inoffensive mussel without the least appearance of giving pain or oppression, although the crab used no precaution in taking light steps in ascending, nor seemed in any way doubtful of the stability of his footing. I watched all day patiently—but no more fibres; after dark, I made my observations only occasionally and by candle-light, the gas being too distant for minute inspection. Returning on one of these visits, after an absence of an hour, I found four new fibres affixed. This was a great disappointment, to lose, by this short absence, a sight I had so much wished to see. Next day there were no more new fibres; and, as it had seven, it might not be in much want of more. To reduce it again to the necessity of making a new supply, I cut four, leaving three, and I again set to watch with renewed zeal.

Darkness came on without bringing about the wished-for object; but to profit by my last night's disappointment, I placed the aquarium on the table, raised to a convenient height for inspection, bringing the gas to bear effectually upon it by means of a flexible tube; and, so far as the facility of inspection went, all seemed right, with little probability of disappointment. Believing that it could not remain long without the support of more fibres, and to awaken it to a sense of that necessity, I agitated the water by rocking the jar slightly from side to side. But I began to perceive, to my dismay, that the water was in an unhealthy state; I replaced it with an artificial mixture, in which all appeared to revive. Next morning all seemed to be again healthy, yet the mussel had thrown out no new fibres since I cut the four. By the afternoon, I had got a new supply of sea-water, and substituted it for the artificial, which gave a renewed stimulus to the whole. I now observed that the motions of the mussel were frequent: after a short time, it threw out, with considerable force, two small, well-defined streams of milk-like fluid from an aperture at the posterior margin of the anal current, which shot like two silvery wires through the water, then gradually opened and broke up into a beautiful shower of feathery-looking flakes precipitating rapidly to the bottom. The streams continued at intervals for about a quarter of an hour, and towards the end, when more scanty, they became finer and single. I believe the white matter to be ova. I subjected it to the microscope, and found it composed of little transparent globules, filled with granular matter surrounded by a delicate membrane, and, when ruptured, the contents flowed out freely. At the close of the milky discharge, the animal became more restless, and the valves opened more widely. The foot now began to protrude and feel about, and fixed for a few seconds on the jar, then darted in with great force: it seemed to be very sensitive, often withdrawing from a slight touch on its own fibres; again the foot protruded more than an inch, and fixed to the jar; the animal now began to move forcibly up and down, as if endeavouring to drag itself from the byssus; the peduncled attachment was seen at every pull rising above the valves of the shell; these motions lasted about five minutes, the foot still adhering to the glass, when, to my joy, I saw a very fine fibre stretched up by its side, and a white spot coming distinctly into view under the tip of the foot.

I have since placed other mussels in separate jars, and cut all the byssus close by the shell; in five hours afterwards, some had three, others four and five fibres; next day, one of them had eighteen fibres; and again the following day one of them had cast its byssus, and had attached itself three inches farther up the jar by the new fibres before it disengaged itself from the old. I have now often seen the fibres fixed; the part of the foot that performs this office is at a point a little below the apex. When more than one fibre is attached at a time, the lower one is fixed first, then the foot is pushed a little farther up on the same line, and a second and a third are fixed in the same way; but I have never seen more at a time than three, sometimes two, and often only one.

Notice of the Natural History of St. Kitts. By the late J. R. Elsey, jun., Esq.

To the Editors of the Annals of Natural History.

Gentlemen,—I received the enclosed account of St. Kitts from my late friend Mr. J. R. Elsey, who, on his return from the arduous North Australian Expedition, was obliged to go to St. Kitts for the recovery of his health. He there very shortly fell a victim to fever.

Yours truly,
J. E. Gray.

"St. Kitts, Nov. 29, 1857.

"I have now been in the island a week, and am able to give you some little account of it. The hills and small table-land abound with very fine land-shells. These parts are rarely visited, and I know of no one who has been up Mount Misery, or collected in the hills. About 2000 feet up among the hills is a very singular table-land, well watered: this is, I expect, a rich field. At the south, limestone and chalk are said to exist. If so, they will create a variety. On the leeward side of the island, near the town, there is a coarse sandy beach; about half a mile south of it, the *terras*, as it is called, underlying the surface-soil, runs down to the water, forming a low cliff, with a shallow ledge and broken rocks under it. This is a fine spot for all sorts of Actiniæ, Echini, Star-fishes, Nereids, Nudibranchs: these are singularly beautiful. I have a small aquarium with some of these in it, doing very well. I should like to know something of the Nudibranchs. On the opposite windward side, a low reef (coral?) runs along the shore at some 50 yards distant. Within is a smooth pool of water, from 1 to 5 feet deep, with ledges of rock, forming a glorious field for examination; outside it deepens rapidly. There are also large still ponds of salt water; these are not very healthy, but will doubtless be worth dredging."

"Dec. 14, 1857.

"I forward you this day a small parcel containing Lepidoptera; one box with them *fixed in position*, the other with them wrapped up flat in pieces of paper.

"A box of 27 species of sea-shells.

"A box containing shells from *terras*, or beds of recent (present?) formation, forming the subsoil from the shore to the foot of the hills.

"As regards Lepidoptera, I am anxious to know in which way they travel best. The weather has been too wet to get any night-moths; but when I move from this spot, as I shall soon, for a week or two, I hope to make a more interesting collection.

"I am preparing at my leisure the lingual ribbons of all the Mollusca I can lay my hands on, and am anxious to know their correct names.

"I hope to send to you shortly good specimens (2 feet square) of the *terras*; it contains, I think, both land- and sea-shells,—*Arca*, *Nerita*, *Lymnea*?

"I have been laid-by the last three or four days by a severe headache, relieved only by lying down ; and as soon as this mail goes, I must seek rest for a day or two."

Alas! he died in a few days, at the early age of twenty-four.

On the Nidification of Crustacea.

To the Editors of the Annals of Natural History.

8 Mulgrave Place, Plymouth, March 13, 1858.

Gentlemen,—In the paper on the 'Nidification of Crustacea,' recently published in your Journal, I omitted to notice the observations of Mr. Gosse on the subject in his 'Rambles of a Naturalist on the Devonshire Coast,' p. 282. He there records, under the title of the 'Caddis Shrimp,' taking an Amphipod that occupied a tube, which he presumed had been constructed by the occupant, and suggests the probability that Say's species may likewise have built its case. The crustacean found by Mr. Gosse was, from the careful figures that he has made of the *pereiopoda*, evidently a *Siphonocetus*, and not a *Podocerus*, as he stated ; although, from a communication I have had with Mr. Gosse on the subject, it appears to be surrounded by species of the latter genus.

It is due to Mr. Gosse that reference should have been made to his early and interesting notice of these animals, the omission of which in my paper I much regret.

I am, Gentlemen, Yours obediently,

C. Spence Bate.

Note on the Occurrence of Dasya venusta. By Dr. J. E. Gray, F.R.S., V.P.Z.S. &c.

This plant was discovered by Miss White, in 1846, in Jersey, and finer specimens have since been found in the same island by Miss Turner ; but hitherto it has not been recorded as found on the coast of England. Mrs. Gray collected several specimens of it on the 5th of October, 1855, on the shore of Bognor in Sussex, and I have lately received a very fine specimen from Brighton.

Prof. Owen's Lectures on Palæontology.

The following Course of Lectures is now being delivered at the Theatre of the Museum of Practical Geology, by Prof. Owen, F.R.S., Superintendent of the Natural History Departments, British Museum.

Lectures I. and II. (*March* 18*th and* 19*th.*)

Fossil Birds.—Various modes in which the evidences of evanescent things become recognizably preserved in rock: such as meteoric phænomena, foot-prints, soft and soluble plants and animals ; causes operating to render scarce the fossil remains of birds. None as yet found in strata anterior to the tertiary period: evidence of birds in earlier formations afforded by foot-prints. Peculiarities of the feet of birds ; of the numerical ratio of the phalanges of the toes.

Application of the anatomical facts to the foot-prints of the New Red Sandstone of Connecticut. History of the discovery and determination of the *Ornithichnites*: exemplified by the *Brontozoum, Steropezoum, Ornithopus,* and *Plectropus.* Eocene Ornitholites. *Lithornis vulturinus*; process of its determination. The sternum in birds: conditions of its peculiarities: its relations to flight; its more constant and important subservience to respiration: these involve corresponding modifications of the scapular arch, of the ribs, and of the vertebræ of the neck, sacrum, and tail. Skull; wing-bones, femora, tibia, metatarsus, and toes. *Halcyornis toliapicus, Gastornis parisiensis, Protornis glarisiensis, Numenius Gypsorum, Tringa Hoffmanni, Phœnicopterus Croizeti.* The gigantic extinct wingless birds. *Dinornis, Palapteryx,* and *Epyornis.* The Dodo and Solitaire.

LECTURES III. AND IV. (*Thursday, March 25th, and Friday, March 26th.*)

PALÆOZOIC AND TRIASSIC REPTILES.—General characters of the Class *Reptilia.* Characters of the existing Orders:

1. *Batrachia.*
2. *Ophidia.*
3. *Lacertia.*
4. *Chelonia.*
5. *Crocodilia.*

Relations of the Osseous structure to the low temperature and inactive habits of reptiles. Characters of the Vertebræ of the different orders of reptiles. Modifications of the Vertebral column in *Batrachia,* and conditions of the absence of true ribs in this order.

Earliest known evidences of air-breathing Vertebrata. The *Leptopleuron* of the Old Red Sandstone. Batrachian foot-prints in American coal-measures. Batrachian fossils of equal antiquity. *Archegosarus, Dendrerpeton, Baphetes, Parabatrachus.* Thecodont lizards of the Permian limestones; *Palæosaurus.* The Thuringian Monitor, or *Protorosaurus.* Probable nature of the so-called Cheirotherian foot-prints in Triassic sandstones, and their relation to the reptiles of the Labyrinthodont family. Characters and remarkable dentition of that family; its combined Batrachian and Sauroid affinities; *Cladeiodon, Belodon.* Reptiles of the German 'Muschelkalk,' *Nothosaurus, Simosaurus, Tanystropheus,* and *Placodus.* The *Rhynchosaurus* of English New Red Sandstone. The Dicynodonts, probably Triassic reptiles of South Africa.

LECTURES V. AND VI. (*Thursday, April 15th, and Friday, April 16th.*)

OOLITIC REPTILES.—Extinct reptiles of the Oolitic series: their numbers, diversity, and formidable character. Views of the classification and affinities of reptiles, as modified by the insight now gained into the forms and structure of the lost orders, genera and species.

Characters of the extinct *Enaliosauria.* Distinctive characters of the vertebræ of the *Ichthyosaurus*: peculiarities of the rest of its skeleton; its dentition and integument. Indications of the structure

of the intestinal canal, and demonstration of the food of the *Ichthyosaurus,* afforded by its petrified debris. Principal species of the *Ichthyosaurus,* and their range in space and time. Osteological and dental characters of the *Plesiosaurus* and *Pliosaurus.*

Lectures VII. and VIII. (*Thursday, April 22nd, and Friday, April 23rd.*)

Characters of the order *Dinosauria.* Osteology and dentition of the principal genera: *Megalosaurus, Hylæosaurus,* and *Iguanodon.*

Characters of the *Pterosauria,* or winged Reptiles. Principal species of the Pterodactyle, traced from the Oolitic to the Cretaceous formations, where they become extinct.

Lectures IX. and X. (*Thursday, April 29th, and Friday, April 30th.*)

Peculiarly modified vertebral column of the *Crocodilia* of the Oolitic period, exemplified in the *Teleosaurus, Poikilopleuron, Cetiosaurus,* and *Streptospondylus.* Dermal armour of *Goniopholis.* Dentition of *Geosaurus, Suchosaurus,* and *Polyptychodon.* Insectivorous Lizards of the Purbeck period: incidental notice of contemporaneous mammalia.

Gigantic marine Lizards of the Cretaceous period: *Mosasaurus, Leiodon*: the small *Dolichosaurus* and other contemporaneous reptiles, in which the procœlian type of vertebra is established.

Lectures XI. and XII. (*Thursday, May 6th, and Friday, May 7th.*)

Oolitic Chelonia and Tertiary Reptiles.—*Chelonia*: earliest indications of this order of reptiles afforded by foot-prints in Triassic Sandstones. Marine Turtles of the Wealden: estuary species of the extinct genera *Pleurosternon* and *Tretosternon* of the Purbeck beds. Turtles of the cretaceous strata. Extinct species of *Trionyx, Chelone, Emys,* and *Testudo* of the tertiary strata. The gigantic *Colossochelys* of the Himalayan tertiaries.

Modern forms of Batrachia in the tertiary series: the *Palæobatrachus* and *Palæophrynus.* Gigantic extinct Salamander (*Homo diluvii testis* of Scheuchzer); Cuvier's demonstration of its true nature. Discovery of a similar existing reptile in Japan. Tertiary Crocodiles, Alligators, and Gavials.

The *Megelania,* or gigantic Lizard of Australia.

Order *Ophidia.* Earliest known fossil remains of serpents in eocene tertiary strata. Vertebral characters of *Palæophis* and *Paleryx.* Summary of the evidences of the cold-blooded Vertebrata in the past periods of the earth's history, and comparison of the general nature and numbers of the extinct and existing reptiles. Conclusion.

We subjoin the following conclusion of the 4th Lecture, delivered on the 26th of March, from the notes of the Professor:—

"The conformity of pattern in the dermal, semi-dermal, or neuro-dermal bones of the externally well-ossified skull of *Polypterus, Lepi-*

dosteus, Sturio, and other Salamandroid ganoid fishes, with well-developed lung-like air-bladders, and of the same skull-bones in the *Archegosaurus* and the *Labyrinthodonts* :—the persistence of the notochord (*chorda dorsalis*) in *Archegosaurus* as in *Sturio* :—the persistence of the notochord and branchial arches in *Archegosaurus* as in *Lepidosiren* :—the absence of occipital condyle or condyles in *Archegosaurus* as in *Lepidosiren* :—the presence of labyrinthic teeth in *Archegosaurus* as in *Lepidosteus* and *Labyrinthodon* :—the large median and lateral throat-plates in *Archegosaurus* as in *Megalichthys* and in the modern *Arapaima* and *Lepidosteus* :—all these characters point to one great natural group, peculiar for the extensive gradations of development, linking and blending together fishes and reptiles, within the limits of such group. The Salamandroid (or so-called 'Sauroid') Ganoids—*Lepidosteus* and *Polypterus*—are the most piscine, the true Labyrinthodonts are the most reptilian, of the group. The *Lepidosiren* and *Archegosaurus* are intermediate gradations, one having more of the piscine, the other more of the reptilian, characters. The *Archegosaurus* conducts the march of development from the fish-proper to the Labyrinthodont type : the *Lepidosiren* conducts it to the perennibranchiate batrachian type. Both illustrate the artificiality of the supposed class-distinction between fishes and reptiles, and the naturality of the Hæmacrymes, as the one sole and truly definite group of cold-blooded Vertebrata. There is nothing in the known structure of *Archegosaurus* or *Mastodonsaurus* that truly indicates a belonging to the Saurian or Crocodilian order of reptiles. The exterior ossifications of the skull and the canine-shaped labyrinthic teeth are both examples of the Salamandroid modification of the ganoid type of fishes.

The small proportion of the fore-limb of the *Mystriosaurus* in nowise illustrates this alleged saurian affinity ; for though it be as short as in *Archegosaurus,* it is as perfectly constructed as in the Crocodile, whereas the short fore-limb of *Archegosaurus* is constructed after the simple type of that of the *Proteus* and *Siren.* But the futility of this argument of the sauroid affinities is made manifest by the proportions of the hind-limb of *Archegosaurus.* As in *Proteus* and *Amphiuma,* it is as stunted as the fore-limb ; whereas in *Mystriosaurus,* as in other Teleosaurians, the hind-limbs are relatively larger and stronger than in the existing Crocodiles. M. v. Meyer leaves the hind-limb out of sight in his advocacy of the saurian nature of the so-called *Archegosaurus.* I regret that v. Meyer's original name '*Apateon,*' though proposed to express his scepticism of the alleged nature of the fossil submitted to him in 1844 by Dr. Gergens, was not retained by Prof. Goldfuss. It is still more to be regretted that a compound name should in any case be adopted or constructed, where the proof of the affinity it may be meant to indicate is not perfect. *Archegosaurus,* like *Mastodonsaurus,* will, I trust, become at length mere arbitrary terms ; but until then, they will really recall or express little more than the mistaken views of the inventors of those names in respect of the true affinities of the remarkable extinct piscine reptiles to which they have been applied."

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 5. MAY 1858.

XXVII.—*On a new Fossil Cirripede.* By James MacAdam, Esq., F.G.S.

For several years I have been collecting fossils from the cretaceous formation of the county of Antrim, and my collection is now tolerably extensive, so that I purpose ere long to publish a catalogue of it. This formation extends from the southern to the northern end of the county, and its basseting edges may be easily examined,—in some places near the sea-coast, in others at a short distance from it. It may be well seen in the immediate neighbourhood of Belfast, from which town to Larne the beds are very interesting, and have furnished me with great numbers of organic remains. At different times I had obtained some fossil Cirripedes, but they are by no means of common occurrence. On examining them lately, I distinguished one of a very remarkable shape, which I had found last autumn, near the promontory called Black Head, at the northern extremity of Belfast Lough. The upper beds of the cretaceous formation are a hard white chalk with flints; this graduates into an impure chalk, speckled with particles of greensand; going lower, there is sometimes a kind of sandstone like the firestone of the English upper greensand, sometimes a greenish marl; the lowest bed is a soft, pure greensand. The Cirripedes which I have collected were all from the lower beds. I have not as yet found any in the pure overlying chalk. The specimen which I last procured I showed to Professor Wyville Thomson, of Queen's College, Belfast, who was struck with its resemblance to the *Loricula* described by Mr. Darwin in his Monograph published by the Palæontographical Society. Professor Thomson most obligingly offered to make a strict examination of the specimen for me, and this he has accomplished in the most satisfactory manner. He

has furnished me with a drawing of it, twice magnified, and also with the following minute description, which testifies most fully the pains he has taken, and for the accuracy of which I can vouch most satisfactorily. To Professor Thomsom my warmest thanks are due for his trouble, and to him the entire credit must be given for the palæontological investigation.

Belfast, April 8, 1858.

Description of the Fossil. By Prof. Wyville Thomson.

Class **CRUSTACEA.**

Subclass CIRRIPEDIA.

Family Lepadidæ.

Genus *Loricula* (G. B. Sowerby, jun.).

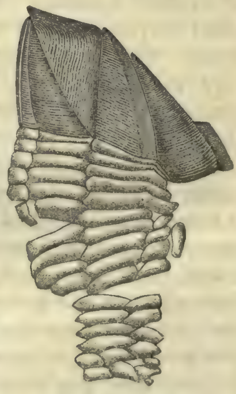
Loricula MacAdami (Wyville Thomson).

Capitulum of (probably) from ten to twelve valves.

Peduncular plates in the seven transverse rows next the capitulum not more than eight in number, the plates adjoining the scutum and scutal latus much lengthened, formed apparently by an amalgamation of two plates, one corresponding to each of the valves.

Locality. Upper Greensand, passing into Lower Chalk. Black Head Bay, Co. Antrim. (Mr. MacAdam's cabinet.)

This interesting specimen consists of one side of a capitulum, well preserved towards the left hand, somewhat shattered and displaced towards the right, showing five nearly complete valves, with the edges of two others, and a peduncle of imbricated plates with the upper portion perfect, or nearly so, on the left, much broken on the right; the lower part somewhat imperfect, but showing well the loricated structure, and produced to a ring of plates forming evidently a base of attachment.



Loricula MacAdami.
Magnified twice.

The matrix is a soft, marly greensand, too friable to admit of the specimen being further exposed with safety. The calcareous plates are preserved,—white, very thin and friable, with a tendency to scale off.

The specimen is in the same position as Mr. Wetherell's unique example of *Loricula pulchella*, Sow., and I shall adopt

Mr. Darwin's nomenclature of the valves. The specimen is still too imperfect to determine the structure of the genus with accuracy, though I rather think that, on the whole, the additional portions preserved add to the probability of the general correctness of Mr. Darwin's restoration. Another view of the structure appears, however, to be possible, and this view I shall explain after having described the specimen in full.

The capitulum consists of five valves, evidently the valves of one side; a small fragment of one scaled off, showing the inner aspect of the corresponding valve in immediate apposition. Following Mr. Darwin, the right-hand valve in the figure is the *scutum*, rather broadly triangular, the base with a convex outline; an obscure ridge traverses the plate longitudinally near the occludent margin, and towards this ridge the nearly transverse lines of growth slightly dip on either side. Beyond the occludent margin a small portion of the convex interior of the opposing scutum has been exposed. Both of the scuta are somewhat displaced downwards, and the opposite peduncular plates are broken.

The *scutal latus* is broadly triangular; its slightly convex scutal margin overlaps the edge of the scutum, and its almost perpendicular tergal margin overlaps the tergum. A ridge passes from the apex to a projecting angle on the base, about one-third of the breadth of the valve from the scutal margin; the lines of growth are nearly transverse, following the contour of the base of the valve, inclining slightly from either side towards the ridge. The *second latus* is a little narrower, the tergal margin concave, overlapping the tergum; the outline of the carinal margin slightly convex; the base straight, exactly corresponding to the second plate of the upper transverse row of the peduncle; growth downwards. The next plate is closely applied to the left margin of the second latus; it is narrow, triangular, almost linear, resting by a narrow, slightly convex base upon the upper plate of the narrow carinal row of peduncular plates, to which it exactly corresponds in breadth, and with whose straight edges its left contour is continuous. This valve is equal in height to the second latus; the lines of growth are transverse, the development having taken place entirely downwards; both lateral margins are well defined, and beyond the left margin the edge of another plate has been exposed, exactly corresponding to it.

Adopting Darwin's idea, this valve must be either one of the valves of a split carina—one of the parietes of a carina in which the tectum is undeveloped; or we must suppose the carina to have been composed of two parietes and a separate tectum, and the tectum to have been lost.

The *tergum* is broadly triangular, inserted exactly as in Darwin's restoration, between the first and second latera; the lines of growth proceed downwards from the upper left-hand acute angle, with an elbow towards the obtuse angle, the elbows forming an obscure line nearly parallel to the upper margin.

The *peduncle* is mailed, as in *Loricula pulchella,* with imbricated plates arranged in transverse and longitudinal rows.

In the part of the side of the specimen preserved, the first seven upper transverse rows are alike. From left to right, a short, nearly square plate corresponds to the base of the linear left-hand valve; the left edge is straight and vertical, the right slightly prolonged, and passing beneath the end of the plate next it in the row, which is longer and narrower, corresponding to the base of the second latus. The third plate is much longer and narrower, following the basal outline of the scutal latus, a depression receiving its projecting angle, then passing on and forming an umbo opposite the junction of the first latus with the scutum, and continued beneath the scutum. Under the middle of the scutum all these plates are unfortunately broken. In all the seven upper rows this plate becomes much narrower towards the rostrum,—this narrowing, rather than the absence of any of the plates of the vertical rows, seeming to account for the depression of the capitulum towards the rostral aspect.

The right-hand portion of the upper rows is lost. Doubtless they ended, as in *L. pulchella,* in another row of small square plates. In the eighth row, the third plate is divided into two, the junction replacing the umbo opposite the scuto-lateral suture. The end of the third plate passes beneath the fourth.

From the tenth row downwards only two vertical rows are partially preserved, the third and part of the fourth. The third longitudinal series seems to be complete, and contains sixteen plates. In the fifteenth and sixteenth transverse rows the plates are smaller and more crowded, the sixteenth forming a distinct ring of attachment. The lines of growth of the peduncular plates are transverse: a slightly elevated ridge, nearly bisecting the plate, indicates the extent to which the plates of each lower row overlap those of the row above it.

Length 1 inch; breadth 0·5. Closely allied to *Loricula pulchella.* One specific distinction is very evident,—the fusion of plates corresponding to the scutum and the scutal latus in the upper rows of the peduncle.

Loricula MacAdami seems to have been gregarious. Some obscure fragments of others of a group are scattered through the matrix.

With the additional information derived from the specimen, the structure of *Loricula* is certainly more anomalous than ever.

The tergum is of the form which Mr. Darwin anticipated, with lines of growth running generally as in his restoration. Instead of an azygous carina, we have a pair of additional symmetrical capitular valves, a junction formed by their symmetrical free edges continuous with the straight edge of the so-called carinal row of peduncular plates.

I am much inclined to think that the left edge of the specimen is complete, in which case we have a cleft carina, with the lines of growth transverse on each separate half.

The specimen might be reversed: then the narrow upright plate would be a reduced scutum; the so-called second latus a rostral latus; the scutal latus would correspond to the upper latus in *Scalpellum,* and the scutum to the carinal latus. The tergum would have its lines of growth passing, as usual, backwards from the upper and anterior angle, and the capitulum would droop towards the carina, which in this case would be accounted absent in both specimens. In the Antrim example, along the right edge there are some broken fragments, which it would require but little imagination to transform into the remains of a narrow carina; and the direction of the valve, perpendicular to that of the lateral plates, would well account for its frequent loss. This view I suggest as possible, but for the following reasons I am inclined to follow Mr. Darwin.

From the probable position of the animal, principally in the upper part of the peduncle, the peduncle is more likely to have been expanded towards the carinal than towards the rostral aspect; and in the Antrim specimen the upper peduncular plates are much narrowed and compressed to the right hand. Where the valves are fully developed, with no deficiency of lime, the size of the scutum always bears a considerable relation to that of the other valves, and is not likely to be so much reduced. The distinct demarcation of the parietes in the carinæ of several *Scalpella* renders the longitudinal division of this valve a highly probable variation. The genus is not yet sufficiently well known to allow us to come to a decided conclusion.

XXVIII.—*A List of the Orchidaceous Plants collected in the East of Cuba by Mr. C. Wright; with Characters of the new Species.* By Prof. Lindley, F.R.S.

Having been favoured by my friend Dr. Asa Gray with a complete set of the Orchids dried by Mr. Wright during his late visit to Cuba, it has appeared to me desirable that some account of them should be published without loss of time; for they serve to show how rich in new species of the Order is the vegetation

of that little-known island, and how much is still open to discovery by the diligent traveller.

Of the 80 species here enumerated 21 are undoubtedly unpublished, while others, such as *Pleurothallis testæfolia*, *Microstylis umbellulata* and *spicata*, *Camaridium vestitum*, and *Chloidia vernalis*, have scarcely been seen by any botanist since the time of Swartz. The localities are copied exactly from Mr. Wright's tickets, which seem to have been written at the time the plants were gathered,—a circumstance that gives them much value in all that concerns colour and form. They also serve to establish with certainty the native country of some species previously known only in gardens, where errors so continually occur in that respect. Examples of this will be found in the case of *Masdevallia fenestrata*, *Prescottia colorans*, and *Spiranthes truncata*.

Pleurothallis *Wilsoni*; (prorepens) folio ovali tridentato caulis longitudine, pedicellis unifloris, bracteis 2 minutis oppositis alteraque sub flore glabro disepalo, petalis oblongis acutis, labello ovato angulato obtuso, capsula ovali glabra.

"S[a]. Isabel, on rocks in woods; on trees in dense woods elsewhere." (668.)

Near *P. angustifolia*, which has serrated petals. There is a specimen from Jamaica, in hb. Hooker, gathered by Wilson.

Pleurothallis *rubigena*; (muscosa) folio oblongo obtuso marginato pedicello filiformi stricto medio bracteato duplo breviore, ovario triptero obovato, sepalis 2 acuminatis glabris, petalis ovalibus acutis, labello rhomboïdeo acuminato obtuso trivenio.

"Mountain tops, on trees in dense woods." (657.)

Differs from *P. acuminata*, Focke, in having much larger leaves, longer pedicels, only 2 sepals, &c. *P. alata*, Rich. and Gal., appears from their unpublished figure to have a large bract beneath each flower.

Pleurothallis *Grobyi*, Lindl. in Bot. Reg. t. 1797. A solitary specimen, mixed with others under the same number. See *P. longilabris*.

"Top of Loma del Gato, on branches of trees." A solitary specimen. (651.)

Pleurothallis *trichophora*; folio ovali obtuso cauli laxe vaginato paulo breviore, racemo longissimo capillari, floribus longe distantibus glabris, sepalis disjunctis ovatis obtuse acuminatis, petalis linearibus acuminatis, labello unguiculato subrotundo ovato 2-cristato, columna cucullata crispa triloba.

"Summit of Loma del Gato, on trees. Flowers dark red." (659.)

Pleurothallis *univaginata*; elongata, folio oblongo obtuso abrupte

petiolato caule valido ascendente uniarticulato longe vaginato breviore, racemis folio subæqualibus spatha magna coriacea, bracteis minutis diaphanis, floribus secundis, sepalis 3: anterioribus basi paulo connatis linearibus obtusis 3-veniis, petalis duplo minoribus emarginatis, labello minore obtuso unguiculato medio constricto, columna marginata.

"Filantropia; mountain-top; in large clumps; epiphytal. Flowers light yellow. Sides of Loma del Gato, on trees." (656.)

In the way of *P. rubens, malachantha, xanthochlora,* and *Jamiesoni,* but quite distinct.

Pleurothallis *albida*; effusa, folio coriaceo obovato obtuso basi canaliculato angustato cauli biarticulato æquali, pedicellis aggregatis paucifloris capillaribus, bracteis hyalinis cucullatis acutis, sepalis linearibus acuminatis subæqualibus discretis, labello sessili lineari acuto infra medium constricto, columna cucullata crispa.

"Flowers yellowish white, on shaded rocks." (655.)

Much like *P. octomeriæformis,* Rchb. f., but smaller, with a different lip and petals.

Pleurothallis *rubroviridis*; aggregata, folio exacte ovali 3-dentato caule alato breviore, bracteis diaphanis ochreatis obtuse acuminatis patulis, floribus tomentosis 3-sepalis, sepalis subæquilateris intus aphthosis, petalis obtusissimis, labello oblongo membranaceo bicristato, columna marginata.

"Monte Verde; epiphytal. Flowers: outer segments green, inner dark red; labellum with green apex." (*No number.*)

One of the crowd to which *Cubensis, aphthosa,* and *fœtens* belong, but smaller in all its parts than any of them.

Pleurothallis *oblongifolia,* Lindl. in Comp. Bot. Mag. vol. ii.

"Summit of Nemanima, on trees." (616.)

Pleurothallis *prostrata*; muscosa, folio lanceolato obtuso caule humifuso bivaginato duplo longiore, pedunculis capillaribus flexuosis folio æqualibus, pedicellis elongatis apice bracteolatis, ovario aspero, sepalis lineari-lanceolatis lateralibus basi connatis, petalis acutis, labello obovato acuto trivenio cucullato.

"Monte Verde, on branches of bushes in dense woods. Flowers greenish purple." (629.)

One of the largest of its section; leaves an inch and a half long; sepals 4 lines long.

Pleurothallis *hymenantha,* Lindl. in Bot. Reg. sub t. 1797.

"Loma del Gato, on trees in dense woods." (*No number.*)

Pleurothallis *fallax,* Rchb. f. in Bonplandia. (*Dendrobium tribuloides,* W., and probably *Pleur. spathulata,* Ach. Rich. and Galeotti.)

"Faralones; epiphytal. Flowers vermilion-colour. Sepals (two

lower united) tuberculate within on the upper half; lateral petals rugulose within, with innumerable shining facets. Lip curved towards the apex, and ciliate-serrulate on the edges. Petals, lip, and col. about half the length of sepals." (663.)

PLEUROTHALLIS *longilabris*; muscosa, folio longe petiolato lanceolato acuto marginato pedunculo capillari flexuoso paucifloro breviore, pedicellis elongatis, sepalis 3 linearibus petalisque laceris acutis, labello sepalis æquali pandurato auriculato unguiculato fimbriato secus axin papilloso.

"Dense woods near Monte Verde, on trunks of Palms. Flowers dark red. Monte Verde, on trunks of trees in thick woods. Calyx dark red, especially the veins, with yellowish-green tips; lateral petals small, very light reddish (the midrib deeper), fine streaks on the margin. Labellum spatulate, dark red, also the edges and midrib of the convolute claw." (651.)

Pl. aristata, to which this nearly approaches, is much larger in all its parts, and has a differently formed lip, not at all longer than the petals.

PLEUROTHALLIS *testæfolia* (*Cymbidium testæfolium*, Swz.); prorepens, rhizomate squamis membranaceis vaginato, folio subrotundo-oblongo tridentato basi unifloro, bractea carinata membranacea dorso lacera, sepalis pilosis dorsali breviore, petalis unguiculatis cuneatis, labello oblongo unguiculato margine lacero medio aspero ad basin limbi alte bilamellato, columna apice cucullata crispa.

"Monte Verde; woods; epiphytal. Leaves dark green, speckled with dark brownish red; a broad channel above, in which lies the flower, and a conspicuous mid-nerve below. Sepals dark red, very hairy externally, the apices connivent, and only opening at the sides. Labellum roundish or oval, covered and fringed with large bristles, very dark red or brown. Lateral petals oblanceolate, deep rose. Andrœcium light red or pink." (648.)

This very remarkable species has no immediate affinity with known species.

PLEUROTHALLIS *Cubensis*; caule alato, folio coriaceo oblongo, spicis sessilibus subbifloris, bracteis membranaceis ochreatis lævibus, floribus tomentosis 3-sepalis, petalis obtusissimis, labello acuto bilineato.

"No locality." (653.)

Near *Pl. fœtens*, but flowers smaller, leaves narrower and not distinctly parallel-veined; sepals half-ovate, not linear, &c.

OCTOMERIA *tridentata*, Lindl. in Bot. Reg. 1839, misc. 43.

"Summit of Loma del Gato, on trees. Flowers greenish white. Column red at base and apex; also the labellum, except the edge, which is whitish." (654.)

Lepanthes *dorsalis*; folio ovato marginato tridentato breve petiolato, caule nigro hispido, pedunculis 2-floris capillaribus folio subæqualibus, bracteis cucullatis ovatis carina hispida, sepalis ovatis æqualibus.........

"Summit of Nemanima, on rocks and trunks of trees." (662.)

Near *L. Schiedei*. The flowers are not in a state to show the structure of the lip and petals.

Lepanthes *chrysostigma*; folio obovato obtuso basi angustato, caule sparse hispido, pedunculis apice distichis folio duplo brevioribus, floribus sessilibus, sepalis ovatis acuminatis divaricatis......

"Monte Verde; Pinal; in thick woods. Flowers purple. Epiphytal." (*No number.*)

In the bud the sepals have a deep yellow stain in the middle.

Lepanthes *fulva*; folio ovato-lanceolato erecto obtuso emarginato, caule glabriusculo multo breviore, pedunculis aggregatis dense multifloris folio duplo brevioribus, floribus sessilibus, sepalis ovato-subrotundis acutis, petalis bipartitis lobis divaricatis æqualibus linearibus obtusis.

"Monte Verde, in thick woods, on trunks of trees. Sepals dull light reddish; petals orange or dark yellow at base, and with the column and labellum purple." (*No number.*)

In the way of *L. Lindleyana* and *andrenoglossa*.

Lepanthes *trichodactyla*; folio subrotundo-ovato basi angustato, caule hirsuto, pedunculis aggregatis a basi multifloris folio dimidio brevioribus, floribus secundis pedicellis arcuatis, sepalis ovatis acutis lateralibus semiconnatis, petalis bipartitis laciniis æqualibus filiformibus erectis, labelli lobo medio triangulari acuto lateralibus obtusis semisagittatis.

"Summit of Nemanima, on rocks. Sepals greenish yellow, with a tinge of red (variable); lateral petals diverging into two narrow lobes, deep red or yellowish red, the lower lobes often crossing each other. Labellum forming a kind of 3-lobed hood around the andrœcium, purple. Most of the flowers seem to be abortive or out of season." (661.)

Flowers large for the genus. Near *L. Pristidis*, Rchb. f.

Masdevallia *fenestrata*, Lindl. in Bot. Reg.

"Monte Verde, in dense woods. Epiphytal. Flowers dull purple." (652.)

Stelis *ophioglossoides*, Swz. Fl. Ind. Occ. p. 1551.

"Loma del Gato, on logs in thick woods. Flowers variable in colour, more or less dark purple in centre, shaded to greenish purple on the edges. Also Monte Verde, in dense woods, on the trunks of trees. Flowers yellowish green, with a tinge of red at base." (658.)

MICROSTYLIS *umbellulata*, Lindl. Gen. et Sp. p. 19.

"Sides of Loma del Gato, in damp shady woods." (613.)

MICROSTYLIS *spicata*, Lindl. *l. c.*

"Mountain-tops in dense woods. Flowers yellow." (614.)

BLETIA *verecunda*, R. Br.

"Sides of Loma del Gato. Flowers light purple." (641.)

BLETIA *patula*, Hook. B. M. t. 3518.

"Mount Friendship; steep hill-sides. Flowers purple." (671.)

BROUGHTONIA *sanguinea*, R. Br.

"Guantanumo. Epiphytal on bushes on the margin of savannahs. Flowers purple, light at the base, and with darker veins near the apex." (665.)

DINEMA *polybulbon*, Lindl. Gen. et Sp. Orch. p. 111.

"On trees in thick woods. Perianth yellow at tip, red towards the base. Labellum white; midrib at the base red. Andrœcium with thin longitudinal red lines, and red at the tip." (649.)

ISOCHILUS *globosum*, Lindl. Gen. et Sp. p. 112.

"Loma del Gato, on branches of trees." (*No number.*)

ISOCHILUS *teretifolium*, Lindl. *l. c.*

"Monte Verde, in thick woods. Epiphytal. Flowers yellow." (*No number.*)

ISOCHILUS *lineare*, R. Br.

"Flower-buds light purple. On trees along mountain rivulets. Monte Verde; epiphytal in dense bunches. Flowers bright purple. Labellum with a darker spot on each side at the same height as the stigma." (633.)

EPIDENDRUM *rivulare* (*Amphiglottia carinata*); foliis lineari-lanceolatis, pedunculo brevi paucifloro inter spathas paucas herbaceas carinatas ipsi æquales, sepalis ovali-lanceolatis, petalis linearibus æquilongis, labelli lobis lateralibus semicircularibus laceris intermedio lineari-truncato carinato basi tuberculato.

"La Perla; margin of a mountain rivulet on rocks. Flowers yellowish green, speckled with red. Column tipped with the same. Labellum white or light yellow." Also "Monte Verde; thick woods. Epiphytal. Calyx and cor. green, speckled with purple or dark red. Labellum white, with a few pink specks." (644.)

This might be placed almost equally well at the end of the Spathian Epidendrums, because of its herbaceous spathes; but their abrupt transition into bracts, and the lip of the species, lead me rather to refer it to Amphiglots.

EPIDENDRUM *umbellatum,* Swz. var.

"Monte Verde; dense woods. Epiphytal. Flowers, sepals, and petals reddish green. Labellum light green, adnate to the column." (645 and 646.)

EPIDENDRUM *umbellatum,* Swz.

"La Perla; mountain sides, on rocks. Flowers light green." (642.)

EPIDENDRUM *ramosum,* Jacq.

No locality. (630.)

EPIDENDRUM *Wrightii* (*Amphiglottia holochila*); foliis coriaceis ovato-oblongis obtusissimis, corymbo longe pedunculato, bracteis lineari-lanceolatis pergameneis acutis, labello ovato carinato etuberculato incurvo nunc utrinque dentato.

"Santa La Madelina. Flowers deep orange." (*No number.*)

A very fine species, related to *E. Skinneri.* My specimen has a stem more than 18 inches high.

EPIDENDRUM *variegatum,* Hooker.

"Monte Verde; epiphytal, in dense woods. Flowers yellowish green, speckled externally with red; labellum and summit of column white." (635.)

EPIDENDRUM *fragrans,* Swz.

"Summits of mountains, on trees. Flowers cream-colour. Labellum white, with thirteen red nerves." (636.)

EPIDENDRUM *nocturnum,* L.

"Monte Verde; woods. Epiphytal. Flowers greenish; petals lighter or white." (*No number.*)

EPIDENDRUM *virens,* Lindl. Fol. Orch. No. 54.

"Filantropia; on trees high up in dense woods. Flowers greenish red; labellum white, with 5 purple lines at the base on each side, and 7 or 9 on the lower two-thirds of the middle lobe." (*No number.*)

EPIDENDRUM *fuscatum,* Swartz.

"Monte Verde; in woods. Epiphytal. Flowers dull red, with darker veins. Also Filantropia; on trees along rivulets. Labellum dull purple, the other parts light brown." (628.)

EPIDENDRUM *Boothianum,* Lindl. Fol. Orch. No. 3.

"Filantropia; on trees in woods." (*No number.*)

EPIDENDRUM *diffusum,* Swz.

"Rocky banks of mountain rivulets." (*No number.*)

EPIDENDRUM *phœniceum,* Lindl. Fol. Orch. No. 98.

"Epiphytal. Perianth dark brownish red. Labellum light red-

dish purple, deeper in the centre, and marked with alternate light and deep lines; lateral segments similarly marked near the base. A deeper line also on each side of the androecium." (*No number.*)

EPIDENDRUM *cochleatum*, L.

"Monte Verde; in dense woods. Epiphytal. Also Filantropia; rocky banks of mountain rivulets. Flowers: outer segments yellowish green. Labellum dark red or purple, with greenish veins in the middle. Androecium whitish at summit, with red lines at base." (646.)

EPIDENDRUM *polygonatum* (*Spathium*); foliis lanceolatis acuminatis, pedunculo longo flexuoso spathis herbaceis carinatis acutis vestito unifloro, sepalis acuminatis, petalis brevioribus angustissimis acutis, labello obcordato axi elevata juxta basin 2-dentata.

No locality. (643.)

Something like a straggling, starved, 1-flowered *E. Harrisoniæ*. The scape or peduncle is between 4 and 5 inches long, bends repeatedly at an obtuse angle, and at each bend has a narrow carinate spathe longer than the internode. The stem below the peduncle is about 3 inches long.

BRASSIA *caudata*, Fol. Orch. No. 5.

"Epiphytal, in dense woods. Flowers light greenish yellow, mottled with reddish brown." (637.)

IONOPSIS *Gardneri*? Fol. Orch.

"Epiphytal, in hedges. Flowers light purple, with deeper veins." (667.)

ONCIDIUM *sylvestre*; (Equitantia) foliis rigidis linearibus falcatis integris, scapo ramoso radicante, sepalo antico bilobo, dorsali et petalis undulatis retusis mucronatis sessilibus, labelli lobo medio sessili cordato lateralibus multo minoribus postice rectangulis, crista quinqueloba $\frac{3}{2}$, columnæ alis semiovatis acuminatis.

"Monte Verde; thick woods. Flowers very light purple. Terrestrial; growing from thick masses of fallen leaves." (670.)

Very near *O. variegatum*, from which the leaves, anterior sepal, and labellum seem to distinguish it sufficiently.

ONCIDIUM *variegatum*, Fol. Orch. No. 38.

"Monte Verde; on bushes. Flowers light purple; lateral petals and lateral lobes of labellum with a light brownish spot at base." (668.)

ONCIDIUM *luridum* β, Fol. Orch. No. 131.

"Epiphytal. Sepals and petals spotted and streaked with yellow and brown, the sepals rather darker." (666.)

ONCIDIUM *Lemonianum*, Fol. Orch. No. 32.

"Sta Catalina; on bushes of Granadilla. Flowers yellow." (*No number.*)

ONCIDIUM *usneoides*; (Equitans) foliis tenuissimis falcatis scapo unifloro stricto filiformi multo brevioribus, sepalo dorsali minimo cochleari, petalis maximis unguiculatis oblatis, labelli lobis lateralibus subrotundis dentatis intermedio cuneato unguiculato emarginato brevioribus, crista maxima quadriloba, columnæ alis erectis semiovatis acuminatis.

"Monte Verde; woods. Epiphytal. Flowers: upper segment small, oblanceolate, white; two lateral suborbicular, unguiculate, white. Labellum with two pairs of lobes and a terminal one, the intermediate smaller, and between the two pairs two yellow carunculæ, the lower one larger, bilobed, the upper channelled above. Terminal lobe broader than long, emarginate, spotted with red, as is also the claw and base of the lateral lobes. Androœcium with a pair of light-purple, wing-like, truncate appendages." (669.)

This singular species looks, without its flowers, like a bit of *Tillandsia usneoides.* It is perfectly distinct from all the equitant Oncids in the characters above assigned to it.

DICHÆA *muricata*, Lindl. Gen. et Sp. p. 209.

"Summit of Nemanima; on rocks and trees." (*No number.*)

DICHÆA *glauca*, Lindl. *l. c.*

"Top of Loma del Gato; on trees." (*No number.*)

DICHÆA ——, sp. n.? Near *squarrosa.* No flowers.

"Summit of Loma del Gato; pendent on rocks." (647.)

DICHÆA *squarrosa*, Lindl. in Plant. Hartweg.

"Monte Verde; woods; on trees." (*No number.*)

CAMARIDIUM *vestitum* (*Cymbidium*, Swz.), Lindl. Gen. et Sp. p. 168.

"Loma del Gato; on trees. Labellum and lateral petals deep pink; upper sepal nearly white, lower and spur dirty white. Also shady mountain-sides, on rocks, in dense bunches.—On Monte Verde. Epiphytal, in dense bunches. Flowers greenish, light towards the base, and with a dull reddish tinge towards the apex. Labellum yellowish white." (650.)

CŒLIA *Bauerana*, Lindl. *l. c.* p. 36.

"Monte Verde; woods. Epiphytal. Flowers white; bracts with a tinge of red." (637.)

POLYSTACHYA *luteola*, Hooker, Exot. Fl. t. 103.

"Loma del Gato. Flowers yellowish green; on rocks." (627.)

Govenia *lagenophora*, Lindl.

"Filantropia; mountain-top, in thick woods. Flowers white; sheath at base full of water." (631.)

Warczewiczella *discolor*, Rchb. f.

"Summit of Nemanima, on trees; mountain-sides, on rocks." (*No number.*)

Lycaste *ciliata*, Lindl. in Bonpl. Oct. 5, 1856.

No locality. (634.)

Maxillaria *crassifolia*.

"Shaded mountain-sides, in dense bunches on rocks." (638.)

Maxillaria *pallidiflora*, Hooker, in Bot. Mag. t. 2806.

"Farallones; on trees, in bunches. Sepals and upper petals yellowish; lip and column white; two lower sepals resembling a cow's horns, and with the broad oblong labellum forming a short blunt spur." (632.)

Comparettia *falcata*.

"Mountain-tops, on trees." (664.)

Vanilla *claviculata*, Swz.

"Monte Verde; in dense woods, climbing high on trees. Flowers light dull red. Labellum light yellow, with a white margin. Column adhering to the labellum more than half its length, reddish towards the base." (672.)

Habenaria *maculosa*, Lindl. Gen. et Sp. p. 309.

"Filantropia. Flowers pure white. Hill-sides." (625.)

Sauroglossum *tenue*; foliis pluribus radicalibus ovatis acutis petiolis æqualibus, scapi vaginis membranaceis acuminatis adpressis, spica 2–6-flora, bracteis apice subulatis ovario æqualibus, petalis spathulatis acutis serratis, labello elongato deflexo canaliculato basi gibboso apice subrotundo-ovato, clinandrio membranaceo cucullato 2-partito laciniis inæqualiter bidentatis.

"Monte Verde; in thick woods. Flowers white." (622.)

A very distinct form of this small genus, now known to consist of three well-marked species. The third, as yet unpublished, is *S. distans*, a Bolivian plant collected by Bridges.

Cranichis *monophylla*, Lindl. in Orch. Linden.; var. foliis geminis brevius petiolatis.

"Loma del Gato; damp shady woods." (621.)

Cranichis *pauciflora*, Swz.

"Filantropia; grassy hill-sides. Flowers: outer segment of perianth greenish white, inner white." (*No number.*)

CRANICHIS *muscosa*, Swz.

"On a rocky islet in a mountain rivulet. All parts of the flower pure white, except the labellum, which has numerous green specks on the inner side." (620.)

PRESCOTTIA *colorans*, Lindl. Gen. et Sp. p. 454.

"Summit of Loma del Gato. Flowers light green." (626.)

PRESCOTTIA *pellucida*; foliis 2 radicalibus subrotundo-oblongis planis denticulatis petiolis 3-plo longioribus, scapo arcte vaginato, spica brevi densa, bracteis ovario longioribus acuminatis, sepalis oblongis petalisque filiformibus reflexis, labello cucullato apice paululum producto.

"Loma del Gato. Flowers greenish or white, and pellucid. Labellum deep green, hooded and arched over. The andrœcium is next the axis, and yet I can see no twist in the ovary." (*No number.*)

STENORHYNCHUS *orchioides*, Richard.

"Filantropia. Flowers carmine. In thick woods." (618.)

SPIRANTHES *elata*, Rich.

"Santa Isabel, in dense woods. Perianth: outer segments green, inner with green claws, the tips greenish yellow, or with a tint of red instead of yellow." (619.)

SPIRANTHES *truncata*, Lindl. Gen. et Sp. p. 470. no. 22.

"Summit of Loma del Gato, in damp woods. Flowers greenish; lateral segments and upper one at the apex reddish." (*No number.*)

PHYSURUS *hirtellus*, Lindl. Gen. et Sp. p. 501.

"Summit of Nemanima. Sepals greenish; upper petals white, spathulate. Labellum white, with the two lobes narrow and curved backward in the shape of horns." (624.)

PHYSURUS *plantagineus*, Lindl. *l. c.* 503.

"La Perla. Flowers white. In dense woods." (623.)

PELEXIA *setacea*, Lindl. Gen. et Sp. p. 482.

"Wooded mountain-tops. Flowers light greenish. Labellum white or yellowish." (617.)

CHLOIDIA *vernalis*, Lindl. Gen. et Sp. p. 484.

"Filantropia; in dense woods. Only one specimen found." (*No number.*)

POGONIA *macrophylla*; (Eupogonia) foliis ovatis cordatis internodiis æqualibus, spica stricta multiflora, bracteis amplexicaulibus herbaceis inferioribus foliaceis.

"Nemanima. Calyx dark greenish purple. Cor. greenish. La-

bellum purple at tip, and on each side of a medium greenish-yellow stripe, edges greenish. Column purple at tip." (615.)

Stem 9 or 10 inches high, erect; leaves 2–3 inches long. The same plant occurs among Linden's collections, but no locality is attached to my specimen. This is the largest of the published species. There is one very like it in Schomburgk's Guiana collections, but my specimens of it are scarcely sufficient for publication.

N.B. *Pogonia Cubensis*, Rchb. f., found in Cuba by Pöppig, is not in Wright's Collection.

XXIX.—*Description of* Camptonyx, *a new Indian genus of Terrestrial Shells.* By W. H. Benson, Esq.

[With a Plate.]

Camptonyx, nov. gen., nobis.

Testa pileiformis, oblique conica, apice libero subspirali, oblique incurvato, versus latus dextrum spectante; anfractibus $1\frac{1}{2}$, ultimo pæne totam testam efformante; costa dorsalis carinæformis subspiralis sulcum interiorem tegens, ab apice usque ad marginem dextrum descendens; apertura maxima, mediana, symmetrica, regulariter ovata, integra, omni latere expansa.

C. Theobaldi, nobis.

Testa (supina) cornucopiam simulante, tenui, concentrice rugosa, purpureo-fusca, dorso ad latus sinistrum compressiusculo, costa carinæformi subspirali, sulco postico adjecto, ab apice usque ad marginem dextrum aperturæ descendente; apice obtuso; apertura ovali, intus purpureo-lutescente, nitida, peristomate acuto.

Long. 10; diam. dorsali $4\frac{1}{2}$ mill.; apert. 8 mill. longa, 6 lata.

Ad latera jugi montis "Girnar" dictæ, Peninsulæ Guzeratensis, invenit W. Theobald junior.

This singular shell, sent to me by Mr. W. Theobald, jun., as a cap-shaped *Succinea*, was found by him in abundance on the central peak of Mount Girnar in Kattiwár, on the peninsula which separates the Gulfs of Cutch and Cambay. He states that these hills form an amphitheatre, with a central crateriform clump, the peak rising to an altitude of 2500 feet. A piece of the weathered rock forwarded by him contains, in a space of 2 inches square, twenty-six young individuals adhering most tenaciously to the surface, like Limpets or *Ancyli*, with indications of the adherence of several larger specimens. The rock sent is a small-grained syenite, with a few specks of mica. A gigantic *Succinea*, 24 millimetres in length, and 15 in breadth, and which occurred of a size larger by $\frac{1}{10}$th of an inch, was found abundant by Mr. Theobald on the same peak.

Had *Camptonyx* been found in a marine locality, it would

have been perhaps regarded as a *Pileopsis*; in fresh water, it might have been taken for an aberrant form of *Ancylus*. The circumstance of the shell not being internal prevents its association with *Parmacella*; while the smallness of the testaceous part of *Testacella* and *Plectrophorus*, compared with their animals, forbids their union with a genus in which the animal is completely covered by the shell, and adheres thereby to flat surfaces. Nevertheless it is probable that *Camptonyx* holds an intermediate place between those genera and *Succinea*, and that it bears the same relation to the latter that *Ancylus* does (through the intermediate Indian genus *Camptoceras*) to *Lymnæa*.

The external rib and furrow on the shell have a corresponding depression and ridge internally, but they are less strongly marked. In the animal the sole is oblong, of a pale colour, transversely corrugated, and surrounded on all sides by a thick greyish hyaline mantle, which completely hides the sole during æstivation, exuding a gluten most tenacious when dried, and which even twenty-four hours' immersion in water, tepid when first applied, failed in some instances to dissolve. The animal cannot be induced to exhibit tentacula or ocular points either by steeping in water or by manipulation with a camel's-hair pencil. There is a slight appearance of two nipples, or a bilobed muzzle, above the narrow fore-end of the sole.

The colour of the cavity of the shell is a rich purplish ochre, and the general aspect betokens rather an inhabitant of the land than of fresh water. Some of the *Succineæ* found with it have precisely the same tinge within the aperture, and have been cemented to rocks by a very tenacious substance. Mr. Theobald was doubtless justified by the situations in which he found his specimens—on a high peak, where the drought, at the time of his visit, had driven the largest examples of the gigantic *Succinea* into inaccessible crevices in the rocks,—in attributing terrestrial habits to the animal. It appears probable that *Camptonyx* only moves in search of food during the height of the rainy season, when the air is saturated with warm moisture, and that its habits are very sluggish.

I have neither the instruments nor the practice necessary for an anatomical examination of specimens so small as those which have reached me with the included animal, and have therefore taken measures for putting them into expert hands. Whether the form may eventually be referred to the *Helicidæ* or to a station near *Ancylus*, or prove to be the type of a new family, I am of opinion that the characters of the testaceous covering will justify the formation of a separate genus for its reception, and on that account I have considered it advisable not to

delay publication until an investigation of the animal can take place.

Cheltenham, 10th April, 1858.

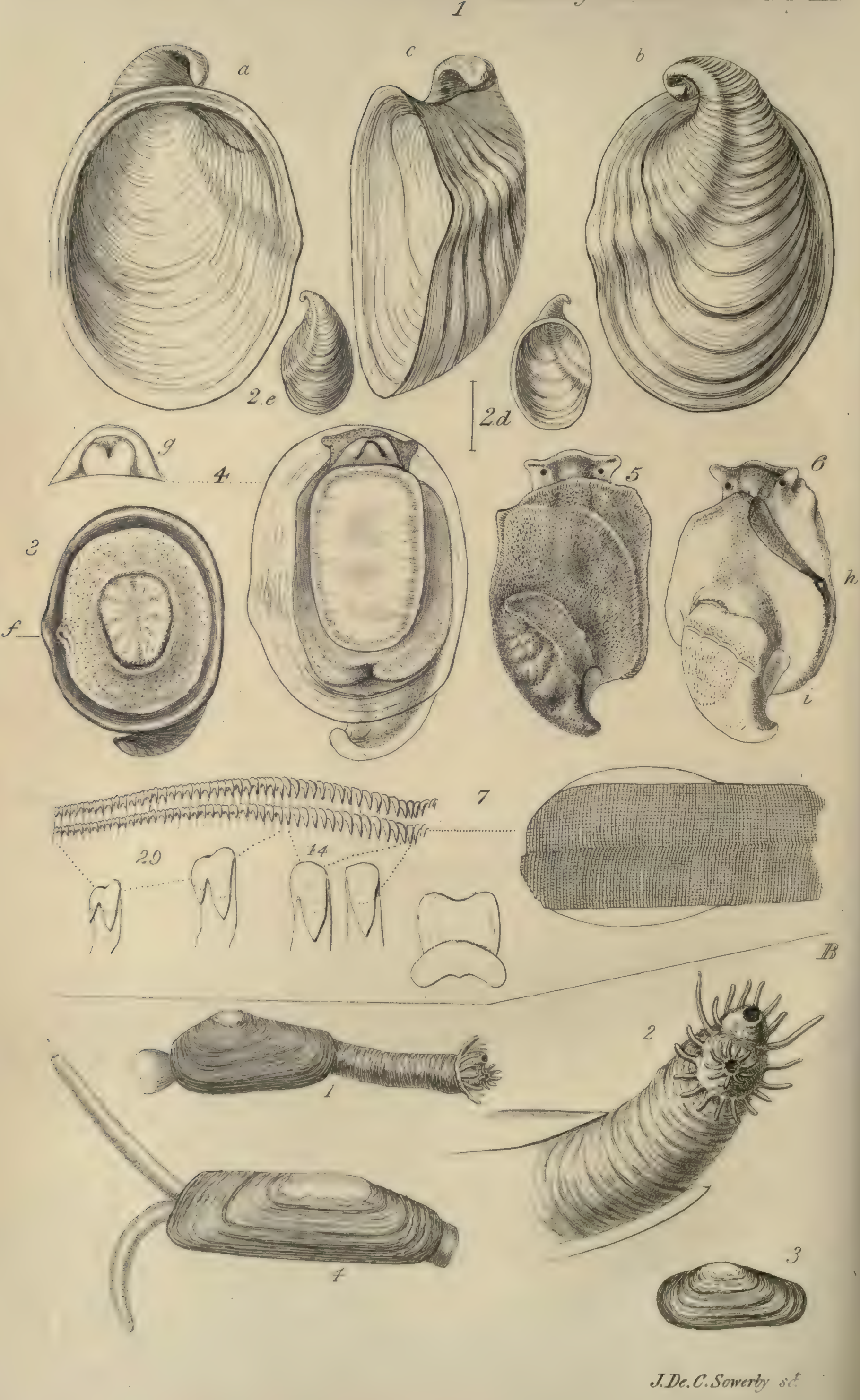
I have much pleasure in adding the following note embodying the results of an examination which Mr. S. P. Woodward has had the kindness to undertake.

Mr. Woodward writes—"The shell appears to be closely allied to *Ancylus,* but differs in being dextral (in which respect it agrees with the subgenus *Velletia*), and especially in having a respiratory channel or siphon on the right side." Subsequently, Mr. Woodward states his belief that *Camptonyx* differs considerably from *Ancylus,* which he had not at hand for comparison, and adds the following description of the animal, as viewed under the microscope:—

"The respiratory orifice is quite on the edge of the mantle. The tentacles are rather conical than angular, and the mouth appears to me rather peculiar, unlike *Physa* and *Lymnæa.* The upper mandible is conspicuous, slightly lobed, but destitute of the ridges seen in the Helicidæ, and of the lateral elements which are added in *Lymnæa.* The lingual ribbon is ·036 long and ·014 wide, with 86 rows of teeth, 87 in a row $\frac{(43\,.\,1\,.\,43)}{86}$; they have simple obtuse hooks, as in *Ancylus*: the central row only differ in being symmetrical; the laterals diminish gradually from the 14th to the 43rd, and a second (outer) cusp makes its appearance, and increases until the three near the margin are regularly bicuspid. This tongue is more like *Ancylus* than any other, but differs from it in the absence of those unarmed marginal plates which give a peculiar appearance to the lingual ribbon of *Ancylus,* and are still more conspicuous in *Velletia.* If I had seen nothing else but the tongue, I should have pronounced it a new subgenus of *Ancylus.*"

Taking everything into consideration, I think that I am justified in regarding the shell as the type of a new genus. The belief that the habits of the animal are terrestrial, and that abundant moisture, such as occurs periodically in a tropical climate, without actual immersion in water, suffices for its support during its season of activity, appears to me to be confirmed by the opening of the respiratory orifice into the lateral channel of the shell*. This conduit may perform the same office as the

* A subsequent examination of the piece of rock, under a lens, revealed a minute globose *Succinea,* probably the young of the large species mentioned, firmly adhering among the remaining specimens of *Camptonyx,* and proving that these two genera exist in the same medium.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J. De. C. Sowerby sc.

shelly tube which communicates with the interior in so many of the mountain-loving oriental Cyclostomidæ.

In Mr. Woodward's drawings, the position of the ocular points, widely separate from each other, is on the upper side of the head. They are sessile at the middle of the hinder part of the base of the short obtuse tentacula, and are visible only from above; whereas in Gray's figure of *Ancylus* (no. 52. p. 216, ed. noviss. Turton) the eyes appear below, and are stated to be placed on a small lateral lobe on the side of the base of the triangular truncated tentacle*. In *Lymnæa,* where the eyes appear on the upper side of the head, they are in front, prominent, and approximate to each other. The position of the eyes in *Pythia* (*Scarabus*), which I had an opportunity of examining some twenty-three years ago at Calcutta, more nearly represents that of the corresponding organs in *Camptonyx*.

The littoral genus *Siphonaria,* which Dr. Gray places between the Auriculidæ and Cyclostomidæ, is remarkable for the presence of a deep siphonal groove on the right side. Again, the large Tertiary fossil genus *Valenciennia,* Rousseau, supposed to have been an inhabitant of brackish water, has a channel running from the under side of the beak of the shell to the right side of the aperture, much like the dorsal one of *Camptonyx*. It is supposed by M. Bourguignat to serve as a sheath to a siphonal tube. It probably communicates, as in *Camptonyx,* with the respiratory orifice, and does not necessarily contain a special organ. The strong concentric ribs of *Valenciennia* present a curious analogy to the rugose surface of *Camptonyx*.

17th April, 1858.

EXPLANATION OF PLATE XII.

Fig. 1. *a,* Shell of young *Camptonyx* viewed from the aperture; *b,* dorsal view; *c,* side view.
Fig. 2. *d,* Adult shell; aperture; *e,* dorsal view.
Fig. 3. Live animal in the shell; *f,* siphon.
Fig. 4. Dead animal in the shell; *g,* muzzle.
Fig. 5. Dead animal extracted from the shell, dorsal view.
Fig. 6. Ditto; *h,* respiratory orifice; *i,* adductor muscle.
Fig. 7. Teeth.

All the figures are greatly magnified.

* Dupuy's description of the animal of *Ancylus,* and the details given in Moquin-Tandon's 'Mollusques de France,' plates 35 & 36, help to confirm the differences observed.

XXX.—*On some additional Palæozoic Bivalved Entomostraca from Canada.* By T. Rupert Jones, F.G.S.

To the Editors of the Annals of Natural History.

Gentlemen,

Within the last week, Mr. E. Billings, Palæontologist of the Geological Survey of Canada, has, at Sir W. E. Logan's request, submitted for my examination a series of Silurian bivalve Entomostraca from Canada, which comprise far better individuals than any that I had previously seen.

This collection includes specimens of *Leperditiæ* from two localities; namely, 1. The east side of St. Joseph's Island, Lake Huron; and, 2. East Point, Anticosti.

No. 1. A small specimen of grey Trenton limestone, containing a Bryozoon, and weathering yellowish, bears a right valve, $\frac{21}{40}$ inch long, and $\frac{13}{40}$ inch broad; and there is a separate perfect carapace of the same form ($\frac{11}{40}$ inch thick) from the same limestone. The valves are of a light-brown colour; the eye-spots are indistinct; the radiate markings of the muscle-spot are more visible on the left than on the right valve; the overlapping ventral edge is neither straight, nor symmetrically curved; the general form of the lower half of the carapace is rounded and bulky.

No. 2. A piece of light-grey limestone (of the Upper Hudson River group) bears on its weathered surface Encrinital ossicles and eleven separate valves of a *Leperditia* of different sizes; and there is a separate perfect carapace of the same form (half an inch long, $\frac{13}{40}$ inch broad, $\frac{8}{40}$ inch thick). These specimens have a rather short hinge-line, a well-marked ocular tubercle, and a muscle-spot visible only by its slightly darker tint. In some instances these valves appear to have a peculiar delicacy of make and substance; they slope rapidly from the central convexity; the ends of the carapace are thin; and the overlapping part of the right valve is distinctly central and neatly curved. This form (No. 2) differs from that of No. 1 in having a shorter hinge-line and a more prominent eye-spot; in the apparent absence of external radii to the muscle-spot; in the somewhat more delicate substance of the valves; in the less thickness of the carapace, in its attenuated edges before and behind, and in the symmetrical curvature of the overlapping ventral edge.

The St. Joseph's form more nearly resembles the large variety of *Leperditia Canadensis* (Pl. IX. figs. 16 & 17) than do the Anticosti specimens; and, as I did not feel authorized to separate specifically the little Grenville varieties, that from Louck's Mill, and that of Allumette, neither can I regard, at present, these

comparatively large and well-grown specimens as belonging to another specific type. This Trenton form, which I propose to term *L. Canadensis,* var. *Josephiana,* may possibly be the same as Conrad's *L. fabulites;* if so, his name has priority.

The neatly shaped *Leperditia* from Anticosti more nearly resembles its almost gigantic allies of Sweden* than do any other American *Leperditiæ* that I have seen. Still it is not without good points of relationship with *L. Canadensis*; and, for the present at least, I propose to term it *L. Canadensis,* var. *Anticostiana.*

In the series brought me by Mr. Billings there are several specimens of Leperditia-rock from the Chazy limestone† of L'Orignal, Canada.

No. 3. Amongst these I recognize, in fragments from "near the N.W. corner of the township of L'Orignal, C. W.," the *Isochilina Ottawa,* under similar conditions to those in which it occurs at the Grenville Canal, except that in one specimen it is associated with a *Modiolopsis*-like shell. I have only to remark, that, when the shell is broken off, the casts of the valves show a distinct muscle-spot (concave on the inner side of the valve) with numerous radii.

No. 4. Several specimens of a dark-grey limestone, labelled "1 mile west of L'Orignal," are rich in valves (separate) of a handsome *Leperditia,* which, at first sight, has much the aspect of *Isochilina Ottawa*; but it is larger, blacker, has a proportionally shorter hinge-line, the hinder portion of the valves being boldly and obliquely rounded, forming about one-third the length of the carapace; and, though the valves have a marginal rim, this is only on the two ends, being wanting below, where the middle third of the ventral border is turned in, overlapping on the right, and overlapped on the left side. The surface is smooth; the eye-spot prominent, and accompanied by a slight, irregular nuchal furrow; muscle-spot indistinct. The carapace is $\frac{8}{20}$ in. long, $\frac{5}{20}$ in. broad, and $\frac{3}{20}$ in. thick, and most convex at the anterior third.

Though numerous in the rock, the individuals are not massed together in layers, as the *Isochilinæ* are at L'Orignal, Grenville, and White Horse Rapids. I propose to distinguish this well-marked species by the name of *Leperditia amygdalina.*

I take this early opportunity of correcting some important

* Annals Nat. Hist. 2 ser. vol. xvii. p. 85. pl. 6.

† This stratigraphical horizon is nearly coincident with that of the "two-foot limestone" and Isochilina-bed described in the April No. of the 'Annals,' pp. 245 and 248, as being at or near the summit of the "Calciferous Sandrock."

mistakes in the references to Plate X. in my paper in the April No. of the 'Annals.'

At page 250, line 7 from top, *for* figs. 10, 11, *read* figs. 8, 9.
line 16, *for* 10 & 11 *read* 8 & 9.
line 24, *for* 7–9 *read* 7, 10, & 11.
At page 251, line 4 from top, *for* 8 & 9 *read* 10 & 11.

I am, Gentlemen, yours &c.,
T. Rupert Jones.

Geol. Soc., Somerset House,
April 8, 1858.

XXXI.—*On the* Canellaceæ. By John Miers, F.R.S., F.L.S. &c.

Having been engaged for a long time in the study of the *Clusiaceæ*, I have been led to examine the several genera that have been referred at different periods to that family, and in this manner *Canella* and *Cinnamodendron* came under my especial notice. The former genus was arranged by DeCandolle and Choisy in *Guttiferæ*, but it was partially separated from the order by Martius and Endlicher, and made the type of a suborder of that family under the name of the *Canellaceæ*, associating with it *Cinnamodendron* and *Platonia*. It will, however, be seen that *Canella* has no relation with *Platonia*, but that its real affinity tends towards the *Winteraceæ*. I will therefore proceed to state my reasons for this conclusion, will expose the characters of both groups, and describe their genera severally.

This small family consists only of the two genera above mentioned, *Canella* and *Cinnamodendron*. They form evergreen trees, with a bark possessing the taste and smell of cinnamon; they have a copious foliage of alternate, somewhat fleshy, exstipulate leaves, which are furnished with dotted glands, and have a taste similar to that of the bark: the flowers are small, in short axillary or terminal corymbs, having a persistent calyx of 3 sepals, 5 petals with dotted glands, or sometimes 10 petals in 2 series, extrorse monadelphous stamens, a unilocular ovarium with two or more parietal placentations; a small, baccate, 1-celled fruit, containing a few black, shining, reniform seeds having a parietal attachment. Many of these characters are possessed by the *Winteraceæ*, from which the *Canellaceæ* differ in the union of their stamens into a monadelphous tube; in the shape and disposition of the anther-cells; and in lieu of several distinct carpels, they have only one solitary unilocular ovary, with 2 to 5 parietal placentations. In the former family, whether there be several ovaria, or whether by abortion they be reduced to one, these, although 1-celled, invariably exhibit a single placentation along the ventral face.

1. Canella.

The plant upon which this genus was founded was first described by P. Brown in his 'History of Jamaica.' During a long time it was considered to belong to the same genus as *Drimys Winteri*, a small tree growing in Tierra del Fuego, near the Strait of Magellan; for the bark of both species had for some time been used in commerce, as mentioned by Clusius in 1605, under the name of *Cortex Winterana*, and confounded with the white bark *Canella alba*, a name afterwards given exclusively to the Jamaica kind. By Linnæus the latter was also considered to be the produce of a species of *Wintera* (*W. alba*, L.). Murray, in his edition of Linnæus's 'Syst. Veg.,' appears to have first distinguished it generically from the Magellanic species, calling it *Canella alba*, a name by which it has since been universally known. The earliest details of its general characters were furnished in 1788 by Swartz, in a memoir published in the first volume of the Linnæan Transactions; and in the same year, Gaertner described the structure of its seed and embryo. Swartz, however, was correct in stating its berry to be unilocular, and from 2- to 4-seeded; but Gaertner, generally so accurate in his observations, erred by adopting the character of Linnæus, who characterized it as being 3-celled,—an error which has been perpetuated by most botanists to this day, notwithstanding that its true structure was subsequently indicated by Cambassèdes.

Jussieu, in his 'Genera Plantarum' (in 1789), referred *Canella*, together with *Symphonia*, to the simple-leaved section of the *Meliaceæ*; but subsequently*, in his observations upon this family (1817), he excluded it altogether from the Order, on account of its seminal structure and the character of its leaves.

Choisy (in 1823) referred the genus to the family of the *Guttiferæ*, because of its monadelphous stamens, which appeared to him sufficient to establish a relationship with *Symphonia* (*Moronobea*), an idea first indicated, but soon abandoned by Jussieu; and in the following year (1824) the same position was again assigned to it by Choisy in DeCandolle's Prodromus (i. 563).

By Nees and Martius (1825) it was still referred to *Meliaceæ*, together with a new species from Brazil†, to which they gave the name of *Canella axillaris*, which plant was afterwards made the type of a new genus, *Cinnamodendron*, by Endlicher‡.

Cambassèdes (in 1828) exposed the fallacy of the ground upon which *Canella* had been placed by Choisy among *Guttiferæ*, and first pointed out the real structure of the ovary in this genus§; but his observations have been neglected by succeeding botanists.

* Mém. Mus. iii. 347.
† Nova Act. Acad. Cæs. xii. p. 18. tab. 3.
‡ Gen. Plant. p. 1029.
§ Mém. Mus. xvi. 395.

Adrien de Jussieu (1830), in his monograph of the *Meliaceæ*, offered valid reasons* for its exclusion from that family, as well as from the *Guttiferæ*, without assigning, however, any positive locality for this genus.

Prof. von Martius (1829), in his 'Gen. et Spec.' iii. 163, described at some length and figured a new genus, *Platonia*, founded on another Brazilian tree having much the habit of the *Guttiferæ*. This genus he proposed to associate with *Canella* in a new family, the *Canellaceæ*, which he placed next to *Guttiferæ*, which view was adopted by Endlicher in his 'Genera Plantarum,' who then added to it his new genus *Cinnamodendron*.

Prof. Lindley (1836), in his 'Introduction to Botany' (p. 76), followed the example of Endlicher in adopting the *Canellaceæ*, and in placing it next to *Guttiferæ*; but subsequently (in 1846) he changed his views, removing the former family as a suborder of the *Pittosporaceæ*†, and considering the *Canellaceæ* as intermediate between it and *Olacaceæ*.

Richard‡ suggested its affinity with the *Ternstrœmiaceæ*.

Choisy (1850), in his last review of the *Clusiaceæ*§, has somewhat modified his former view by adopting the suggestion of Richard, and in placing this small group as a suborder of the *Ternstrœmiaceæ*, an affinity that can be justified only as regards *Platonia*, which genus, though of proximate relationship, cannot be referred to that family‖.

In the midst of such conflicting authorities, it appeared to me desirable to search for more certain grounds on which to base the true affinities of this small group: it is now some time since, with this view, I investigated carefully the structure both of the flower and seed; and this examination led me to place it in a position very different from any yet assigned to it, for it appears to me that the *Canellaceæ* must range close to *Drimys* and its congeners, as I shall proceed to show.

The details of the structure of *Canella*, as originally given by Swartz¶, are tolerably correct: the flower has three persistent, imbricated sepals; five deciduous fleshy petals imbricated in æstivation; its stamens are united into a fleshy, monadelphous tube

* Mém. Mus. xix. 185.

† Veg. Kingd. 442.

‡ Flore de Cuba, p. 245.

§ Mém. Soc. Phys. Genève, xii. 381.

‖ This genus I consider to belong to the *Moronobeaceæ*, a group I propose to separate from the *Clusiaceæ*, and which will comprise *Moronobea*, *Chrysopia*, *Platonia*, and two new genera,—*Perissus* (the type of which is *P. lucidus*, from Rio Negro, Spruce, 2159), and *Catalissa* (founded upon *C. Blanchetiana*, from Bahia, Blanchet, 1671). In a memoir yet unpublished, I have described all the above genera and their species, giving at the same time the characters and affinities of the Order, which I consider to be intermediate with the *Ternstrœmiaceæ* and *Hypericaceæ*.

¶ Linn. Trans. i. p. 99. tab. 8.

that entirely encloses the pistil, the anthers consisting of 20 distinct linear cells, which are affixed extrorsely upon it; the ovary is 1-celled, and furnished with two opposite parietal placentæ, which arise from the base, and upon each of these in the middle are seen two reniform ovules attached horizontally right and left by a short and broad funicle in the sinus. The fruit, like that of *Drimys*, is baccate and unilocular, containing four slightly reniform, oval, rounded seeds, enveloped in a syrupy, aromatic mucilage; their external tunic forms a hard, shining, black, crustaceous shell; and on the ventral face, just above its sinus, is seen an open scar or hilar spot, indicating the point of its suspension; while a little above this is a small obsolete prominence, corresponding with an internal point, to which the enclosed nucleus is attached. On breaking this internal tunic, the nucleus is found covered with a tolerably thick coating of a loose tissue, in which is imbedded a short thread-like raphe enclosing spiral vessels, proceeding from the point of attachment just mentioned, and terminating in a thickening of the proper integuments seen on the ventral face, just below the sinus. This envelope of loose texture is quite analogous in its structure to a similar development in the seed of *Drimys*, which I have elsewhere more minutely described, differing only in its component cells being filled with mucilaginous instead of fatty deposits; the origin, course, and termination of the raphe being alike in both cases: so also the innermost integuments are similar in texture to those of *Drimys*, and though slightly agglutinated together, are separable at all points except about the spot where the raphe terminates in a broad, circular, dark, areolar thickening of their substance, where they are intimately connected. The position and direction of the embryo, in very copious albumen, offer other striking points of resemblance; although the embryo is much larger and more elongated in *Canella*, and more minute in *Drimys*, still the cotyledons in the former, though proportionally longer, are terete, and the extremity of the radicle in both cases is closely contiguous to the point of suspension of the seed. One feature, worthy of especial notice, is even more strongly developed here than in *Drimys*: the direction of the embryo does not correspond with the axis of the albumen; nor do the cotyledons tend towards the chalaza, but lie on the contrary side, in quite an excentrical position. I have observed in *Canella*, as well as in *Drimys*, within the body of the albumen, the remains of the embryo-sac extending from the cotyledonary extremity of the embryo, surrounded by soft mucilaginous matter. From the above facts we may draw the same conclusion in regard to the nature of these several tunics of the seed in *Canella* that I have done in that of *Drimys*,—viz. that the external crus-

taceous tunic, being quite free from the raphe which is imbedded in a more internal envelope, must be a development subsequent to the growth of the true coats of the ovule, and that it is in reality an arillus: that the intermediate tunic in which the raphe is imbedded is the arilline*, while the innermost integuments immediately covering the albumen are the testa and tegmen, as shown by their areolar thickening at the chalaza. The characters of the genus, as I have observed them, may be defined thus:—

CANELLA, *Murray, Linn. Syst.*; *P. Brown. Jam.* 215; *DC. Prodr.* i. 563; *Endl. Gen.* 5457. Winterana, *Linn. Gen.* 598.—*Sepala* 3, suborbiculata, concava, coriacea, margine ciliata, suberecta, persistentia, æstivatione imbricata. *Petala* 5, uniseriata, sepalis fere duplo longiora, oblonga, concava, crasso-carnosa, erectiuscula, quarum 2 paullo angustiora et interiora, decidua, æstivatione imbricata. *Stamina* in tubum cylindricum petalis æquilongum monadelpha, *tubo* carnosulo e disco parvo scutelliformi hypogyno producto, apice ultra antheras breviter extenso, ibidem tenuiori et pellucido-punctato, margine fere integro aut subcrenulato; *antheræ* extrorsæ, e locellis 20 subæqualibus dorso omnino adnatis, linearibus, compresso-angustis, parallelis, sejunctis, rima media longitudinali 2-valvatim dehiscentibus: *pollen* reticulatum. *Ovarium* superum, cylindricum, vel conico-oblongum, glabrum, 1-loculare; *ovula* 4 reniformia, e medio ad placentas 2 oppositas longitudinales parietales per paria collateralia horizontaliter appensa, *funiculo* brevi in sinu affixa. *Stylus* crassus, ovario continuus et æquilongus, os tubi attingens. *Stigma* truncatum, obsolete bilobum. *Bacca* ovata, carnosa, calyce immutato suffulta, stylo breviter apiculata, 1-locularis. *Semina* 4, in mucilaginem condita, rotundato-ovata, subreniformia, hilo minusculo cavo sub apicem notata; tunica externa (*arillus*) dura, crystallino-crustacea, lævis, nitida, sub lente confertim granulata, atra; tunica intermedia (*arillina*) externa conformis, sub apicem apiculata, et hinc ad illam paullo super hilum affixa, membranacea, latere ventrali ab apice usque ad medium *raphide* filiformi percursa; *integumentum internum* (e 2 agglutinatis) crassiusculum, obscurior, *chalaza* majuscula ventrali notatum. *Embryo* in verticem *albuminis* copiosi carnosi et eo 4-plo brevior versus faciem dorsalem reconditus, hinc valde excentricus, teres, curvatus; *radicula* extremitate crassiori hilo proxima, *cotyledonibus* semiteretibus chalaza aversis æquilonga.

Arbores *Antillanæ et Columbianæ sempervirentes summo ramosæ*;

* Huj. vol. 278; Linn. Trans. xxii. 81.

folia *alterna obovata vel oblonga, coriacea, juniora pellucido-punctata, glabra, integerrima, superne nitida, petiolata, exstipulata:* inflorescentia *terminalis, corymbosa,* floribus *subparvis, albido-violaceis.*

1. *Canella alba,* Murray, Linn. Syst. iv. 443; P. Brown, Jam. 275. tab. 27. fig. 3; Catesby, Carol. ii. tab. 50; Swartz, Linn. Trans. i. 96. tab. 8; DC. Prodr. i. 563. Canella Winterana, *Gaertn.* i. 377. tab. 77. Winterana canella, *Linn. Sp.* 636; Lam. Dict. viii. 799. tab. 399;—arborea, 10-orgyalis et infra, cortice griseo gusto cinnamomi donata; foliis oblongo-obovatis, integerrimis, nitidis, crassiusculis, tenuiter anastomoso-nervosis, pellucido-punctatis, vetustioribus opacis, subtus pallidioribus, petiolo crassiusculo canaliculato; corymbo terminali folio sub-breviori; pedicellis flore æquilongis, petalis violaceo-albis.—In Antillanis.—*v. s. in herb. e Jamaica, Cuba, et viv. in hort. Kew. cult.**

This tree, of which a history has been given in a preceding page, seems to have been confounded to this day with a kind of *Cinnamodendron* presently to be described. I am led to believe, that the true *Canella alba* grows chiefly in the forests of the mountains of Jamaica, where its upright trunk attains a height of 50 or 60 feet, with terminal abundant foliage; while the *Cinnamodendron* just alluded to rises in the plains, forming a branching shrubby tree, from 10 to 15 feet in height. It remains to be seen whether the *Canella* described as existing in the Bermudas and other West India Islands be identical with it, or whether it be a distinct species. The specimens I have seen from the island of Cuba appear specifically the same as those from Jamaica. The bark taken off the branches for commercial purposes is double, the outer one being grey, and of the thickness of a shilling, while the inner bark, sought after by druggists, under the name of *cortex Canellæ albæ*, is double that thickness, of a paler colour, and of a more pungent and aromatic taste. The leaves are about 5 inches long, 1¼ inch broad, on a petiole about 4 lines in length. The corymb, much branched, seldom exceeds 1 or 1½ inch in length; the pedicels are 3 lines long; the orbicular sepals 2 lines in diameter; the petals about 3 lines long; the staminal tube about the same length; the 20 anther-cells, little more than a line long, are equidistant from each other, separated by a very narrow interval, and open by a medial line along their whole length. The berry is oval, about 5 lines long and 4 lines in diameter; it generally bears 2 to 4

* A figure of this species, with structural details, will be given in plate 23 A. of the 'Contributions to Botany.'

seeds, which are black, shining, $2\frac{1}{2}$ lines long, $1\frac{3}{4}$ line in diameter, and are somewhat reniform on the ventral face.

There appears to be still another kind of *Canella*, but whether a mere variety, or a distinct species, remains to be ascertained. It is mentioned by G. Don (Dict. i. 680) under the name of *C. laurifolia*, as forming a tree 15 feet high, and growing in the West Indies. Plants of it were raised from seed at Hackney by Loddiges in 1817 (Lodd. Cat.). It has terminal flowers, as in *Canella alba*; but its leaves are narrower, more lanceolate, considerably longer, and of a much paler green colour. The plant cultivated at Kew under the name of *C. alba* quite corresponds with that described by Don; its leaves are $3\frac{1}{2}$–$4\frac{1}{2}$ inches long, 1–$1\frac{1}{4}$ inch broad, upon a much stouter petiole 4 lines in length; they are tapering at both ends.

2. *Canella obtusifolia*, n. sp.;—ramulis teretibus, rugosis, cortice aromatico tectis; foliis obovatis, apice rotundis, e medio versus petiolum cuneatis, integerrimis, supra nitidis, subtus pallidis, crassiusculis tenuiter anastomosanti-nervosis, pellucido-punctatis, margine revoluto, petiolo sub-brevi, tenui, semitereti, superne plano: corymbo paucifloro terminali, folio multo breviori; bacca minori, ovata, stylo apiculata et calyce suffulta.—Maracaibo.—*v. s. in hb. Mus. Paris* (Plée, 720)*.

The specimen upon which the above species is founded has no flowers; but there can be no doubt that it is really a *Canella*, because of its terminal flowers, while in the two species of *Cinnamodendron* the flowers are constantly axillary. The berry and seeds are also quite those of *Canella*, and differ in shape, size, and appearance from those of the genus just mentioned. The leaves are 2 to $2\frac{1}{2}$ inches long, including a petiole of 3 lines, and are 12–14 lines broad. The inflorescence is very much smaller than in the preceding species, where it forms a broad spreading panicle, partly terminal, and partly axillary at the two ultimate leaves, rather more than an inch long, and 2 inches broad: this panicle is ternarily branched in three or four subdivisions; the first or main peduncle is 4 to 6 lines long; the secondary pedicels are 3 lines, and the tertiary pedicels, each supporting a flower, are 4 lines in length. On the other hand, in *C. obtusifolia*, the raceme is quite terminal, simple, few-flowered, and only 4 lines in length, the main peduncle being 2 lines, and each pedicel $1\frac{1}{2}$ line long, the berry being less in size than that in the preceding species; it is 4 lines in length and 3 lines in diameter: the one I examined contained only two seeds, lying

* This species, with analysis of its fruit and seed, will be shown in the 'Contributions to Botany,' plate 23 B.

horizontally and superimposed, one apparently from each placenta, and filling the whole space of the cell, where they are surrounded by a small quantity of thin glutinous mucilage. The seeds are black and shining, and are constituted precisely as in the species before described.

2. Cinnamodendron.

This genus was proposed by Endlicher* for a Brazilian plant first described by Nees and Martius, under the name of *Canella axillaris*†, since which, nothing has been recorded respecting it. I have lately had an opportunity of examining that plant, and find the details above referred to sufficiently correct; but the evidence I have now to communicate, regarding a second species, establishes beyond doubt the validity of the genus, and its close affinity to *Canella*. This second species has so much resemblance to *Canella alba* in its general characters, especially in the similar properties of its bark, that the two have been confounded together in commerce. It differs, however, in having axillary flowers, while in *Canella* they are terminal: they agree with one another in their odoriferous and aromatic qualities, in the number and form of their persistent sepals, in the union of their extrorse stamens into a monadelphous tube, in the number and shape of their anther-cells, and in the size and shape of their ovary and style; but *Cinnamodendron* differs from *Canella* in its rotate calyx and corolla, in the presence of an inner row of petals, in a different stigma, in the number of its parietal placentations, in the great number of its ovules, and its much smaller and more numerous seeds. In the specimen I examined of Martius's plant, I could not determine the number of its placentæ, as the flowers were in bud, and the ovary consequently in a very early stage of development; but in the Jamaica species I have found that the placentations are generally 5, sometimes reduced to 4, the number of ovules being very considerable: in *Canella*, on the other hand, the placentæ are constantly 2, and the number of ovules does not exceed 4, all of which, or sometimes only 2, are matured into seeds. I have remodelled its generic characters in the following manner:—

Cinnamodendron, Endl. (Char. reform.) *Sepala* 3, orbiculata, rotatim expansa, coriacea, margine ciliata, persistentia, æstivatione imbricata. *Petala* 10, biseriata; 5 exteriora oblonga, sepalis dimidio longiora, carnosa, expansa, æstivatione imbricata; 5 interiora membranacea, spathulato-oblonga, pellucido-punctata, exterioribus alterna et vix æquilonga, iisque erectiora:

* Gen. Plant. 5458. † Nov. Act. Acad. Cæs. xii. p. 18. tab. 3.

omnia decidua. *Stamina* in tubum cylindricum petalis æquilongum monadelpha, *tubo* tenui e disco parvo scutelliformi hypogyno producto, longitudinaliter 10-nervio, pellucido-punctato, margine ultra antheras breviter porrecto et hinc brevissime 10-lobo, sinubus cum nervis alternantibus, lobis vix retusis; *antheræ* extrorsæ, tubi dimidio longitudine, locellis 20 subæqualibus, dorso omnino adnatis, linearibus, compresso-angustis, parallelis, sejunctis, rima media longitudinali 2-valvatim dehiscentibus, valvibus tenuibus nigro-punctulatis; *pollen* globosum, reticulatum. *Ovarium* superum, cylindricum, glabrum, 1-loculare; *ovula* plurima, reniformia, horizontalia, e sinu ventrali ad placentas lineares parietales sæpius 5 (rarius 4) demum incrassatas et carnosas appensa. *Stylus* crassus, ovario continuus et vix angustior, tubum stamineum attingens, vel paullulo ultra exsertus, brevissimus, obtusus: *stigmata* sæpius 5 (rarius 4) peltato-glandulæformia, margine fimbriata, summo styli extus adnata. *Bacca* ovata, carnosa, calyce immutato suffulta, stylo breviter apiculata, 1-locularis, placentis parietalibus 5 carnosis prominulis axin non attingentibus seminiferis munita. *Semina* (circiter 10) in mucilaginem condita, ad placentam per paria funiculo brevi horizontaliter appensa, cum plurimis semi-abortivis mixta, clavato-reniformia, tuberculata, compressa, subnitida, granulata, *hilo* ventrali minusculo sub apicem notata: tunica externa (*arillus*) crystallino-crustacea, fragilis, fusca; tunica intermedia (*arillina*) lævis, sub apicem apiculatum, versus hilum appensa, hinc per sinum ventralem *raphide* loriformi percursa, crasso-membranacea: integumenta interna bina (*testa* et *tegmen*) membranacea, subadhærentia, *chalaza* majuscula ventrali notata. *Embryo* in *albumen* carnosum copiosum 3-plo longius summo versus faciem dorsalem excentrice reconditus, *radicula* summo attingens et hilo proxima, tereti, *cotyledonibus* vix latioribus acutis dorso parallelis chalaza remotis 3-plo longiori. Arbores vel arbusculæ Brasilienses et Antillanæ *virescentes, ramosissimæ;* folia *ovata vel oblonga, coriacea, nitentia, pellucido-punctata, breviter petiolata, vernatione involutiva.* Inflorescentia *axillaris, racemosa, pauciflora, petiolo parum longior,* floribus 3 *ad* 6 *pedicellatis,* pedicellis *alternis, imo bractea obtusa adpressa donatis.*

1. *Cinnamodendron axillare,* Endl. Canella axillaris, *Nees et Mart. Nov. Act. Acad. Cæs.* xii. 18. tab. 3;—arboreum, cortice glabro, albicante, transversim crebre rimoso et calloso; foliis alternis, ovato-ellipticis, obtusiusculis, glabris, margine integro crenulatim undulato revoluto, supra nitidis, subtus pallidioribus, reticulato-venosis, crassis, coriaceis, petiolo brevi inferne

carinato; racemis axillaribus petiolum paullo superantibus, sæpius 3-floris, floribus parvis, pedicellis puberulis, calyce æquilongis, imo 2-bracteatis, petalis exterioribus carnosis, interioribus tenuioribus fere æqualibus, pellucido-punctatis, stylo paullo exserto, truncato.—Brasilia, ad San Pedro dos Indios, circa Cabo Frio, in Prov. Rio de Janeiro.—*v. s. in hb. Hooker* (Martius)*.

This is described as a middle-sized tree: its leaves are from $1\frac{3}{4}$ to 2 inches long, and 14 to 15 lines broad, on a petiole 3 lines long: the racemes are few-flowered, and scarcely measure more than 4 lines in length: the flowers, when ripe, are only one-third the size of those of *Canella alba*; in the specimen above referred to they are in bud, but sufficiently advanced to make out the several parts. I found the inner row of petals glabrous, not ciliated, as described in the 'Nova Acta,' and equal in size to the outer row, not minute and squamiform; the anther-cells also are linear, not ovate, in which respects they agree with the following species. The tree is called by the natives '*Hierba moeira do Sertão,*' as mentioned in Spix and Martius's Travels (Reise, i. p. 83, ii. p. 336).

2. *Cinnamodendron corticosum*, n. sp.;—arboreum, biorgyale, ramosum, ramulis tenuiculis, flexuosis, lenticellis maculatis; foliis elongato-oblongis, utrinque acutiusculis, apice attenuatis, glaberrimis, integris, tenuiter anastomoso-nervosis et valde reticulatis, supra nitidis, subtus pallidioribus, et glanduloso-punctulatis, punctis porosis et minutissime pellucidis, margine revoluto, rachi petioloque brevi superne canaliculatis, infra carinatis; racemulis axillaribus, brevibus, 3–4-floris, petiolo paullo longioribus, pedicellis striatis, puberulis, flore præcedentis 2-plo aut 3-plo majori; ovario 1-loculari, ovulis numerosissimis in placentis carnosis prominentibus 5 (rarius 4), biseriatim affixis: stylo tubo æquilongo, stigmatibus 5 (rarius 4): bacca ovata, polysperma.—Ins. Jamaica apud Bath.—*v. s. in hb. Cl. Dom. Hanbury*†.

This is a very distinct species, differing from the preceding in the form and size of its leaves. I am greatly indebted to Daniel Hanbury, Esq., F.L.S., who placed his specimens in my hands for examination, and who afterwards kindly sent to Jamaica for samples of the flower and fruit preserved in alcohol, from which I have been enabled to complete the above details. Its bark has the same aromatic properties as that of *Canella alba,* from which

* A representation of this plant will be seen in plate 24 A. of the 'Contributions to Botany.'

† Analytical details and a drawing of this species will be given in plate 24 B, of the same work.

it is scarcely distinguishable, both being collected and exported under the same name. Its leaves are 5–6 inches long, $1\frac{1}{2}$–$1\frac{3}{4}$ inch broad, the petiole being 3–4 lines in length; the raceme is only 4–6 lines long; the berry is 6 lines in length, and 5 lines in diameter, containing about 10 seeds, which are much smaller than those of *Canella*, more reniform, much compressed, very rugose, and 1 line in length.

From the foregoing details of the structure of the flowers and seed of the *Canellaceæ*, we may with some confidence venture to assign the place which this small group should occupy in the system. Its structure is so palpably opposed to that of the *Clusiaceæ* (where *Canella* has generally been arranged by botanists), that it is quite unnecessary to enter into any discussion upon the value of such an affinity. This incompatibility was long ago shown by Prof. Lindley*, as before stated, upon very substantial grounds; he also proved that it could not be associated with *Platonia*, and that Gaertner was incorrect in his description of the fruit of *Canella*. In this uncertainty, he looked to the *Pittosporaceæ* as a more probable affinity. There are certainly several points of similitude between them, but the relationship appears to me very distant: the symmetrical number of the parts in the *Pittosporaceæ*, their petals united at the base into a short tube, their perfectly free stamens with introrse anthers opening by pores in the apex, the deep inflexion and union of the carpels in the centre, where they are placentiferous,—all combine to prove that these two families are far from being akin.

On the other hand, there exists, as I have already shown, a singular degree of accordance in the general habit of the *Canellaceæ* with *Drimys*: the same aromatic principle pervades their bark, leaves, and flowers; they have both similar alternate exstipulate leaves, furnished with transparent dots, and they have unsymmetrical biserial petals, with an imbricated æstivation. There is also a no less striking analogy between *Cinnamodendron* and *Drimys*, as well as *Illicium*, their ovary being unilocular, with longitudinal parietal placentation; and there is a remarkable parallel in the form and structure of the seed. There can therefore be no doubt that a very close affinity exists between these two groups. The *Canellaceæ*, however, will be found to differ from the *Winteraceæ* in their monadelphous stamens, and more particularly in their single ovary. In regard to their relative position in the system, if we follow the basis of the Jussieuan method, adopted by DeCandolle and most botanists, and carried out by Endlicher in his 'Genera Plantarum,' we

* Veg. Kingd. 442.

cannot fail to arrive at this conclusion, that the several distinct ovaries, each formed of a single carpel united by its margins without any inflexion, which margins being on the ventral side and ovuligerous, form there a longitudinal parietal placentation, —characters that belong to the *Winteraceæ,*—unquestionably place that family in the class *Polycarpicæ*. On the other hand, we find in the *Canellaceæ* similar carpels; but instead of being distinct, they are united into one compound ovary by the simple junction of their placentiferous margins, thus forming a unilocular ovarium with compound parietal placentation: this Order must therefore come within the limit of the *Rhœades* of Endlicher, where we find the carpels similarly constituted. Notwithstanding this separation into different classes, it is evident, from the extremely close affinity existing between the two families, that they ought to be in juxtaposition in any linear arrangement; but I will again refer to this subject when I come to discuss the affinities of the *Winteraceæ*.

XXXII.—*Observations on Dr. Hallowell's Paper on* Urodele Batrachians, *and* Trigonophrys, &c., *in the 'Journal of the Academy of Natural Sciences of Philadelphia.'* By Dr. John Edward Gray, F.R.S., V.P.Z.S., P. Ent. Soc. &c.

In the third part of the third volume of the new series of the 'Journal of the Academy of Natural Sciences of Philadelphia,' for February 1858, Dr. Edward Hallowell has published a paper "on the Caducibranchiate Urodele Batrachians," in which he divides these animals into nine subfamilies.

The paper, which is very valuable as regards the accounts of the North American species of the Order, and of the European specimens in the Bonaparte Collection, which has come into the possession of the Academy, is not preceded by any observations, so that its object and intention are not explained. It does not give any account of what has been done on the subject by his predecessors in the same field. Perhaps the author thinks that the less he says on this head the better; or perhaps he may boldly say, like another naturalist on a similar occasion, "I have had no predecessors."

The paper at once commences with the characters of the nine subfamilies; and, as they have no reference to any other authors except in one case, I take it for granted we are to suppose that they are the families suggested and characterized by the author. The exception to which I have above referred is thus marked:— "Ellipsiglossidæ, *D. & B.* = Molgidæ, *Merrem.*" Now, it is to be observed, that neither of the authors so referred to have

families ending in *idæ*,—so that the references are evidently incorrect. Duméril and Bibron use *Ellipsiglossus* as a genus, and Merrem uses *Molge* as the name of the genus which Laurenti had called *Triton*, and which contains all the Urodele Batrachians.

On examining the nine subfamilies characterized by Dr. Hallowell, I find them to be just nine of the tribes or sections of tribes into which I had separated the three families into which I had divided the Order in my Catalogue of these animals published in 1850,—a catalogue well known to Dr. Hallowell, as he quotes it among the synonyma of the species, and criticises some of the observations in it in his remarks appended to the species. Dr. Hallowell's subfamilies are established on the same characters that I used to separate the families and tribes, the characters being only given in a few more words, as if to fit them for a work in quarto. I will now give an abstract, in parallel columns, of Dr. Hallowell's and my arrangement:—

	Gray, Catalogue, 1850.			Dr. Hallowell's Paper, 1858.
Fam. I.	*Salamandridæ*.			
Tribe 1.	*Salamandrina*, *a**,	identical with	I.	Salamandridæ §.
1.	Salamandra	=		Salamandra.
Tribe 1.	*Salamandrina*, *a***	=	III.	*Pleurodelidæ*.
2.	Pleurodeles	=		Pleurodeles.
				Bradybates, young of former.
Tribe 1.	*Salamandrina*, b.	=	VII.	*Tritonidæ*.
	Triton	=		Triton.
	Notophthalmus	=		Diemyctylus, *Raf.*
	Euproctus	=		Euproctus.
	Cynops	=		Triton, sp.
	Taricha	=		Taricha.
	Bradybates	=		Pleurodeles junior?
	Lophinus	=		Triton, sp.
	Ommotriton	=		Triton, sp.
	(Sieboldia in Protonopsidæ)	=		Tritomegas.
Tribe 2.	*Serianotina*	=	II.	*Serianotidæ*.
	Serianota	=		Serianota.
Fam. II.	*Molgidæ*	=	VIII.	*Ellipsiglossidæ*.
	Hynobius and Molge	=		Ellipsiglossus.
Fam. III.	Plethodontidæ.			
Tribe A.	Ambystomina	=	VI.	*Ambystomidæ*.
1.	Onychodactylus	=		Onychodactylus.
2.	Heterotriton	=		Ambystoma, sp.
3.	Xiphonura	=		Ambystoma, sp.
4.	Ambystoma			Ambystoma.
Tribe B.	*Plethodontina*	=	IV.	*Plethodontidæ*.
5.	Plethodon	=		Plethodon.
	(Taricha? sp.)	=		Aneides.

§ In a paper read at the Zoological Society on the 9th of March, 1858, I divided this family into three, viz. *Salamandridæ*, *Pleurodelidæ*, and *Serianotidæ*, but on very different characters from those used by Dr. Hallowell, and containing different genera to the families he has so named.

Gray, Catalogue, 1850.		Dr. Hallowell's Paper, 1858.
Tribe C. *Desmognathina*	=	IX. *Hemidactylidæ.*
6. Desmognathus, *Baird*	=	Plethodon, sp.
7. Hemidactylium	=	Hemidactylium.
Tribe D. *Œdipina*	=	V. *Bolitoglossidæ.*
8. Batrachoseps	=	Batrachoseps.
9. Spelerpes	=	Spelerpes.
Pseudotriton	=	Pseudotriton.
10. Geotriton	=	Geotriton.
11. Œdipus, from Mexico	}	Not noticed by Dr. Hallowell.
Tribe E. *Ensatinina*	}	Not noticed by Dr. Hallowell.
Ensatina, from California	}	Not noticed by Dr. Hallowell.

I think the above list establishes beyond a doubt the identity of my tribes and Dr. Hallowell's subfamilies.

I know that some authors, who are great sticklers for the synonyma of genera, and profess to be very anxious to give the first establisher of the genus the honour of its establishment, do not quote the synonyma of the families and other larger groups; but as it certainly requires a larger power of analysis to form good natural groups of genera than to form genera, especially since it has become the habit to make almost every species a genus, it is certainly more important to the history of science, and but justice to the higher class of scientific labourers, that the history of the groups should be shortly and distinctly given,—more especially as the faculty of success in characterizing such groups appears to be a rare talent possessed by few. It is the possession of this talent that gives the high character to the works of Jussieu, Lamarck, Brown, and Macleay.

Dr. Hallowell, I suppose from not having seen the animal, or probably even a figure of it, places the large Japan "Salamander," *Tritomegas Sieboldi*, in *Tritonidæ*, between *Euproctus* and *Taricha*, to which it has not the most distant relation either in external form, form of tongue, or position of teeth; this genus, on the other hand, is so nearly allied in all these characters to the American genus *Protonopsis* as to be with difficulty separated from it.

It is much to be regretted that authors like Dr. Hallowell should not quote others correctly; thus he states, "Gray observes, that it (*Triton nycthemerus*) is perhaps a young of *T. marmoratus* or *Triton cristatus*." I have not given such an opinion, as I have never seen the animal; but in page 22 of the Catalogue I quote M. Bonaparte's opinion thus:—"Is perhaps the young of *T. marmorata* or *T. cristata* (Bonap. Amph. Eur)."

In the same Part of the Journal of the Academy Dr. Hallowell describes and figures as a new genus and species, a Frog, in the Museum of the Academy, under the name of *Trigonophrys*

rugiceps; but there can be no doubt, from the figure and description, that it is the *Uperodon ornatum* of Mr. Bell, which is figured in the Zoology of the Beagle, p. 50. t. 20. f. 6.

Dr. Hallowell, in a paper in the same volume, describes and figures some Snakes as new, which Dr. Gunther informs me are well-known species, described many years ago, thus:—

Zamenis tricolor, *Hallow.* = Herpetodryas margaritiferus, *Schleg.*
Elapoidis fasciatus, *Hallow.* = Streptophorus Sebæ, *Dum. & Bibr.*

XXXIII.—*On the Relation of the Raphe to the Coats of the Vegetable Ovule.* By Arthur Henfrey, F.R.S. &c.

In the last number of the 'Annals' appeared a paper by Mr. Miers explanatory of his views on the subject named in the heading of this note. A clear statement of opinion is most valuable for the settlement of debated questions; and the setting-out therein of the premises on which all the reasoning depends, is just what is required for the decision of the value of the arguments in the present case.

These premises appear to us open to adverse criticism, taking away the principal grounds of the subsequent arguments. We will consider them *seriatim*, as laid down at pages 276–8.

1. That "vegetable growth in all its stages is regulated by the ordinary laws of mechanical action," is incorrect if taken without qualification, since all the *peculiar* phænomena of organic development are indications of the action of a special force modifying the effects of simple mechanical laws; but this question has no important bearing in the present case.

2. It is by no means true that every tunic of an ovule is formed of three elementary parts, *epiderm, mesoderm,* and *endoderm.* No such distinction of parts occurs in the ovules of *Orchis* and many other plants, where the ovules are composed of comparatively small quantities of cells.

3. Communication of vessels can only take place between one tunic and another at points where they are *organically continuous.*

4. The organic communication of the first and second tunics, testa, and tegmen, is *usually* confined to the vicinity of the chalaza or gangylode.

5. In erect ovules the chalaza is, of course, contiguous to the hilum.

6. In anatropous ovules the chalaza is removed from the vicinity of the hilum; but the inversion of the ovule takes place by a *one-sided development of the tunics of the ovule,*—of the single coat where only one exists, of the *outer coat* where two exist; and the cord of vessels lying in what is called the raphe is organically

continuous with the coat in question, the raphe *being a mere thickening of that coat,* in all the cases which have come under our observation. We have never seen such conditions as are represented in fig. 1 of Mr. Miers's paper, where the testa is shown distinctly separated from the raphe (or placental sheath). The cellular structure is uninterrupted between raphe and testa where the two are in contact, and the line of division running down between *b* and *c* has no existence in any case that we have observed.

7. Consequently there is no necessity that branches of the raphal vessels must set out from the gangylode or chalaza to enter the testa; they may be sent out laterally in any part of the raphe between the hilum and the chalaza.

8, 9 and 10 fall away, if the foregoing statement be correct. We do not venture to assert that it is universally true, but it is the correct account of what we have found to exist in a large number of cases.

As regards specialities referred to in the paper, we must declare in favour of the superior value of such evidence as that furnished by Dr. Gray, in the case of *Magnolia,* to any analogical reasoning, which, in the case of the changes occurring during the maturation of seeds and fruits, is a most unsafe guide. And when Mr. Miers finds a difficulty in comprehending how an originally homogeneous tunic becomes developed into a double layer, one hard and the other soft, we think he must have overlooked the familiar case of the fruits of the *Amygdaleæ,* where the stone and pulp are clearly produced from the simple pericarp.

The cases where a branching of the vascular structure from the hilar end of the ovule takes place, are most simply explained on the above grounds, as developments within the substance of the testa; and the "placentary sheath" is a needless assumption. In the case of *Citrus,* where the branching vessels start from the chalaza, they ramify in the *tegmen,* or inner coat, as this is only organically continuous with the outer tunic and raphe at that point.

April 3rd, 1858.

XXXIV.—*Further Observations on the Nature and Origin of the External Coatings of Seeds.* By John Miers, F.R.S., F.L.S. &c.

The arguments which I lately offered, relative to "the nature and origin of the external coatings of seeds," are founded principally upon the facts recorded by the most eminent physiological botanists, who have described and figured the gradual

progress of the increment that occurs, from the earliest period of the growth of the ovule, to the final ripening of the seed. The most important inference I have there deduced, is, that the external coating of the seed in which the vessels of the raphe are imbedded, derives its origin, not from that which should be considered as the true primine, or outer original tunic of the nucleus, but from an extraneous sac that subsequently grows over that tunic, and which is developed from its funicular support, which I have termed the placentary sheath: in confirmation of this inference, I now proceed to show the manner in which this growth is effected. Wishing to submit the truth of this deduction to the test of observation, I examined lately the growth of the ovule of the Almond, as that is the instance to which I referred, showing the manner in which the vessels of the raphe become distributed over the whole area of its seminal tunic: the result proves the correctness of my inference in regard to the nature and origin of the external coating first mentioned, for I had previously no evidence to demonstrate how and when it was produced.

At the earliest stage observed in the cell of the ovary, the placenta throws out two small bracket-like protuberances, each being the germ of a placentary sheath, and near its extremity there is seen to sprout a small mammillary knob, which is the rudiment of the nucleus: this nucleus, continuing to grow, is soon surrounded at the point of its origin by two small cups: by degrees, the surface of the sheath on which these cups rest becomes channeled, and then more deeply grooved; at which period we may discern, within the body of the sheath, the nourishing vessels essential to the growth of the ovule, proceeding from the placenta and terminating at the point where the nucleus and its distinct cups are attached to it, which point I have called the gangylode. The grooved surface of this support now continues to extend, not at its margin, which scarcely increases, but by the growth of its middle portion, which, expanding downwards, forms at first a shallow, and gradually a deep cup, in the progressive manner shown in the marginal figures (fig. 1), until at length we see it formed into an oblong open pouch, within which is seated the nucleus, partly enclosed in its proper tunics: during this transformation, it will be observed that the margin of the grooved channel of the ovular support, which now becomes the mouth of the pouch, has never changed its original position, remaining on the same level, and in the same contiguity to the placentary point, out of which the support first issued. Here we see produced what is termed an inverted or anatropal ovule: it is, however, important to observe, that in this action the ovule undergoes no inversion whatever;

Fig. 1.

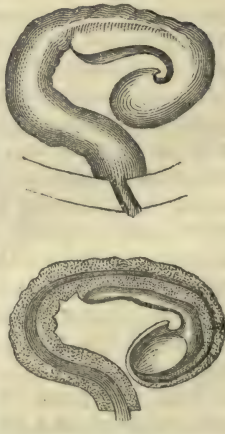
so that the term anatropal has, in fact, been erroneously applied to it, in consequence of a misconception that has originated in the want of attention to the manner in which this mechanical process of growth is effected. By this beautiful and most simple contrivance of Nature, the apex of the nucleus is brought into close proximity to the orifices of the stigmatic channels, there to receive the pollinic influence held to be essential to the generation of the embryo, prior to the final closing of the orifices of the surrounding tunics over it. Subsequently the mouth of the extraneous pouch of the placentary sheath also closes up, and this pouch then assumes the form of an entire coating, as in *Magnolia*, or it occasionally remains pervious, as in *Euonymus*; but we invariably find the nourishing vessels imbedded within its tissues. In ordinary cases these vessels remain as one continuous cord, similar to that first generated within the sheath terminating in the chalazal point, and thus constituting a simple raphe; but in others, like that of the Almond, they divide and spread themselves over the whole breadth of the tissues of the pouch, and form at length a branching raphe. By such simple means all the phænomena attendant upon what is called anatropal inversion are fully understood and explained; and we are thus relieved from the necessity of imagining the more complicated action of the twisting of the ovule round its funicle, and the paradoxical circumstance assumed to take place, of the insinuation of the nourishing vessels into the tissues of the original tunics of the nucleus; for it is clear to me, that all the objections I have urged (*ante*, p. 278) hold good on the assumption generally entertained that the ovule inverts itself, and that in this action its apex is turned round to the point where its base formerly stood, and *vice versâ*; the consequence of which is the production of the raphe upon one of its sides. These objections, however, entirely disappear under the view of the actual circumstances that occur in the manner here shown.

Under this point of view, it is clear that the presence of a raphe, whether as a simple cord, or in a branched state, within the tissues of a seminal coat, indicates with certainty that such

coat has emanated from the growth of the placentary expansion that served as the support of the ovule, and that it has not been developed from one of its proper tunics. Such is the coating I call an *arilline*, in contradistinction to the *testa*, or development of one of the proper tunics of the nucleus, which becomes an integument always devoid of vessels, and generally crustaceous in its texture, whence its name has been assigned; but as this is often reduced to the tenuity of a membrane, sometimes agglutinated to the tegmen, and frequently to the arilline, as in the Almond; or as it sometimes happens that a still more extraneous coating or arillus, formed over the arilline, or possibly the arilline itself, assumes the crustaceous form of the ordinary testa, great misconception has existed in regard to the origin of such integuments, and much confusion has ensued in the terms applied to them. It is true that the pouch or expansion of the placentary sheath above described has often been confounded with, or denominated, the primine; but that does not influence the real state of the case, for in this investigation we must depend solely upon *facts*, that is to say, upon the nature of the integuments themselves, rather than upon the *designations* which botanists have often confusedly applied to these different developments. It was therefore with the object of ascertaining the real nature of the several kinds of seminal integuments, that I entered into this investigation; and in now bringing it to a close, I will subjoin the following elucidation of the real source of the peculiar development which I have above described.

The expansion of the placentary sheath and the peculiar growth of the arilline offer well-marked characters in many families, and these developments take place under very striking circumstances in the *Anacardiaceæ*. It has been assumed, as one of its leading features, that its solitary ovule is always suspended from a long free thread that rises from the base of the cell; this, however, very rarely happens, as I will show in a memoir where the structure of the Order is examined, and characters are given of its various South American genera. I now exhibit in the margin a drawing (fig. 2) of what I have observed in *Pistacia Atlantica*, that genus offering one of the few cases where the funicle rises from the very base of the cell: to this is added a section of the same. Here the cord of nourish-

Fig. 2.



ing vessels, after penetrating through the pericarpial envelopes, suddenly expands into a broad fleshy sheath, in the tissues of which the cord of the raphe is continued till it terminates in the chalazal point of the partly-formed seed: this very elongated sheath is coiled round in a spiral form, and near its extremity there is seen a very deep groove, which terminates in the small open mouth of an oblong pouch, which is a continuation of the sheath, and in which the ovary with its closed tunics is affixed at its base. In this instance, the flower had long before withered, and the ovary had grown to a considerable size, being now above 3 lines in length. Here we have proof of the peculiar nature of the long placentary sheath, and of its pouch-like development: the perfect resemblance of the latter to the analogous pouch above described, as seen by me in the ovule of the Almond, is convincing; and we have here evidence that this pouch can in no way be considered as one of the original tunics of the ovule, and therefore cannot be held to be the primine. I annex the figure of another very instructive example (fig. 3), observed in an abortive ovule of a species of *Drimopus*, the whole of which being transparent, affords a proof of the real structure: here the placentary sheath is straight, and suspended from near the summit of the cell; its lower portion is grooved, and the margins of this groove terminate in the open mouth of an oblong sac, which is an extension of the sheath, similar to that seen in *Pistacia*. We observe at the base of the included nucleus, which is also surrounded by its two open tunics, the common point of their attachment to the bottom of the pouch, in which point we see the termination of the raphe, which thence is traced along the sheath to the place of its origin in the placenta.

Fig. 3.

XXXV.—*On some new Genera and Species of* Crustacea amphipoda. By C. Spence Bate, F.L.S. &c.

Among the Edriophthalmous Crustacea belonging to the Collection of the Royal College of Surgeons, which have been entrusted to me for examination, the following appear hitherto to have escaped being described.

Macrocephalus, n. g.

Cephalon horizontaliter porrectum. *Antennæ* inferiores nullæ.

Pedum *coxæ* corpore fusæ. *Pleopoda* posteriora tria duplicatis partibus divisa. *Telson* cylindraceum.

Macrocephalus longirostris, n. s.

M. cephalo perlonge rostrato (rostro corporis totius $\frac{2}{3}$ longitudinem æquante). *Antennis* superioribus rudimentariis. *Gnathopodis* primi et secundi parium chelatis. *Carpis* dactylorum apice productis.

Presented by Sir E. Belcher.

PLEUSTES, n. g.

Cephalon rostro productum. *Antennæ* superiores quam inferiores longiores. *Coxæ* anteriores quatuor permagnæ. *Gnathopoda* subæqualia et subcheliformia. *Pleopoda* posteriora in duplicatis partibus divisa. *Telson* squamiforme.

Pleustes tuberculata, n. s.

P. pereii segmentis omnibus, *plei* anterioribus duobus tuberculo dorsali medio ornatis. *Pereii* segmentis posterioribus tribus, *plei* omnibus lateraliter tuberculatis. Segmentis *pereii* omnibus, *plei* anterioribus duobus coxarum marginibus tuberculatis. *Pereiopodis* posterioribus tribus *coxis* tuberculatis. *Pleopodis* posterioribus appendice interiore permagno.

Amphitoë lacertosa, n. s.

Ut genus sed *gnathopodo* secundo permagno et chelato.

Arctic regions.

Lysianassa bidenticulata, n. s.

L. antennis inferioribus superiores non superantibus. *Gnathopodis* paris primi *propodo carpo* longiore. *Gnathopodis* paris secundi *carpo propodo* longiore. *Plei* segmento tertio margine posteriori denticulis duobus utrinque producto.

BIBLIOGRAPHICAL NOTICES.

The Ground beneath us: its Geological Phases and Changes. By J. PRESTWICH, F.R.S. &c. London: J. Van Voorst. 1857.

THE geological researches of Mr. Prestwich and their results have been long well known and fully appreciated. Many years has he devoted to the elucidation of the history of the Tertiary deposits of this country; nor have his investigations been in vain, or unproductive of useful consequences; for his researches, independently of their scientific bearings, have been also of a practical kind, as is evinced in the publication of his useful work, 'The Water-bearing Strata of the Country around London*,' a notice of which appeared in a previous Number of this Journal.

* Van Voorst, 1851.

The history of the Tertiary strata must always be invested with some interest, as it was the examination of these deposits around Paris (at the commencement of the present century) that developed some of the germs of true geology, and also called forth the genius of "Cuvier, the great founder of that department of the science of organic remains which relates to the interpretation of the fossil bones and teeth of the vertebrated animals," — whose researches and descriptions were so marvellous, as he successively restored and determined the analogies of that vertebrate fauna which flourished around the margins of the earlier Eocene estuary. Conjointly with his colleague, Brongniart, Cuvier produced a scheme of classification of these French Tertiary strata—strata which, from the researches of Deshayes and others, have yielded an invertebrate fauna richer than that belonging to the British seas, and even exceeding that living at present in the Mediterranean. Parkinson, Webster, and Buckland, in this country, early attempted to synchronize the British deposits with the French classification, which, although generally correct, required some modification; and the true correlation of the two series was subsequently elaborated and defined by Mr. Prestwich. Nor must we overlook the fact, that, when the Molluscan fauna of the British Eocene area is fully worked out, as is now being effected most carefully and thoroughly by Mr. F. Edwards, it will also yield as rich and remarkable a series of Testacea as the foreign equivalent strata.

The metropolis stands upon gravel, which is underlaid by an important member of the Tertiary series, to which it gives its name,—is surrounded by other strata of equal interest,—and yet no popular guide-book has appeared to direct the inquirer or the geological student in his investigations around London. The only special paper (with the exception, of course, of the subsequent general memoirs by Mr. Prestwich) was that published by Parkinson in 1811, 'Observations of some of the Strata in the Neighbourhood of London*.' We may here notice, however, an Appendix to a 'Hand-book for London,' published some years since†, in which the chief geological features of the district are correctly noticed. A guide-book has been a want, as many people have long felt; and this, Mr. Prestwich has to some extent, but not fully, supplied. It is, however, using a term of the author, a "basement-bed" upon which he may hereafter raise another superstructure, and render it more serviceable by appending a list of localities, fossils, &c., after the manner of a special paper on the London Clay, published by him in a late Journal of the Geological Society‡. Still, small as it is, it contains much that is useful and suggestive, and is a valuable and acceptable addition to geological literature.

This little book contains the substance of three Lectures 'On the Ground beneath us,' delivered to the members of the Clapham Athenæum. It was our good fortune to be present at the delivery

* Geol. Trans. 1 ser. vol. i. p. 324.
† Weale, Holborn.
‡ Geol. Journ. vol. x. p. 401.

of these lectures; and we think that the Council of that Institution have acted wisely and conferred a benefit in requesting the author to embody them in a more permanent form. In this manner we are enabled to consult at our leisure the details of those well-explained conclusions, to which we, as well as others doubtless, listened with so much pleasure.

Although apparently confined to the 'Geology of Clapham,' this work really takes a wider range, and describes the nature and character of those geological changes which have taken place in the vicinity of London, embodying at the same time the principal results arrived at by geologists, and a statement of the mode by which the several problems have been worked out. These lectures are divested as far as possible of all technicalities; explanatory notes and references, as well as small but useful illustrations, are given, so as to render the description of the records of the successive physical phænomena which are preserved in the ground beneath us, intelligible to the ordinary reader.

The first lecture is devoted to one of the later, if not the latest period of the earth's history,—the accumulation of the superficial gravel and its associated beds: no geological subject is of more difficult inquiry, few perhaps so interesting. Most of our readers who have examined the excavations for sewage, building, or for the material itself*, are aware that in and around London there is a vast accumulation of gravel, which gravel varies from 3 to 20 feet or more in thickness. The origin of this gravel, the direction from which it has come, the agency by which it has been brought, the period at which it was distributed, and the fact of its being the great source of water-supply to all the shallow wells and land-springs in the district,—are points fully and succinctly treated.

The main bulk of the gravel of London has been derived from the black flints which occurred in the surrounding chalk districts; but this destruction of the chalk must have been very considerable, for it is inferred by the author that it would require a mass of chalk 200 or 300 feet thick to form a bed of flint-gravel 10 feet thick. With the flint-gravel occur cretaceous sandstones, and also, but more rarely, pebbles of quartz, porphyry, and slate, which must have been transported from some distance, as from Wales and the border counties. Mr. Prestwich treats of the possible modes of transport, inferring, with other geologists, that the surface now covered by gravel was under water at the time, and that the distribution might have been effected either by the transient action of a body of water,—or by the action of a large river flowing into the Thames valley,—or by the ordinary power of sea-currents,—or by the agency of coast-ice and icebergs. One fact appears evident, that the surface of the

* The value of this gravel, and its general use for road- or pathways, is well known, and even also as a material for exportation. Some years since, a large quantity was exported from Bayswater to Russia, realizing a considerable sum; and hence, we believe, the origin of local names of buildings and places in that neighbourhood.

district has been considerably modified since certain portions of the gravel were spread over it.

In speaking of the geological position of the gravel, Mr. Prestwich enters into some interesting details respecting the characters and habits of the Mammalia and Testacea belonging to this period, and points out the known, but singular and suggestive fact, that whereas the larger number of the species of the great Mammalia have become extinct, a large proportion of the friable and delicate shells which then frequented the land and rivers of the same countries which the mammals inhabited, have lived through the various geological changes which have since succeeded.

The second lecture describes the structure, age, and organic remains of the London Clay. Although immediately underlying the gravel, yet the two deposits are separated by a wide interval (geologically speaking)—an interval during which numerous marine and estuarine strata were deposited, both in this country and on the continent, and even the mighty Alps attained some, if not the entire portion of their elevation. The London Clay is treated of in regard to its height and extent,—its superposition and relative age,—the description of the character and affinities of the animals and plants which flourished during the period at which the formation was accumulated,—the thickness of the strata, and the number and extent of the successive zones of animal life,—the mineral character and structure of the mass,—and the arrangement of the sediment; "so as to form some opinion as to the probable nature of the climate, the depth of the seas, and the position of land and water at that period of time." This lecture evinces much labour and research; first as regards the principles by which the geological history of past times is deciphered, and secondly, as to the variety and interest of the organic remains of the London Clay. We recommend an attentive perusal of this portion of the work, as treated in a novel, instructive, and pleasing manner, and in which the author acknowledges the sources of his information respecting the fossil remains of the formation, and compares their numerical proportion with those occurring either in Britain or elsewhere. These are treated of in an ascending order.

Commencing with the lowest or most simply organized creatures, the *Foraminifera,* a tribe which swarm in our present seas, and form the food of mollusca and fishes, the author states that ten genera have been noticed, including many species. There are ten species of Corals,—none, however, belonging to the reef-building forms. Of Echinoderms, or the Sea-urchin tribe, there are seventeen species, some of which, as the *Ophiura Wetherellii,* must have been abundant and quietly entombed in the muddy sediment, "since Mr. Wetherell found at Highgate a septaria about 3 feet in diameter, of which the surface was literally covered with hundreds of these delicate radiated creatures in a fossil state."

Although numerous, only eight species of Crustacea had been described at the time of Mr. Prestwich's lectures; but the recent publication by Prof. Bell* indicates 17 species; 4 of *Macrura,* 10 of

* Palæontographical Society, 1856. We cannot but regret that the

Brachyura, and 3 of *Anomura*. On our coasts, at present, between 30 and 40 forms of the Crab, Lobster, and Shrimp tribes are known. The Mollusca number 220 species, including 7 species of *Nautilus*, of which latter only two living species are recorded. About 100 species of fossil fish are numbered, a large proportion belonging to the Shark and Ray tribes, and others having affinities with those of warmer latitudes; while some forms resemble others now so plentiful in the British seas, as the Herring, Eel, Cod, and Whiting. Between eighty and ninety fossil fish have been obtained from the Isle of Sheppey,—a limited area as contrasted with the whole British seas, which contain about 160 species. Of Reptiles about fourteen species now exist in England; but twenty-one species occur in the London Clay, of which eighteen belong to Turtles and Tortoises. There is something suggestive in the fact, that while all the tropical seas of the world have yielded but five species of marine Turtles, no less than ten species have been found within a limited area in the London Clay.

Remains of birds and mammals are very scarce; but the vegetable kingdom furnishes us with a group as marvellous as those of fishes and reptiles in the animal kingdom. Leguminous plants and Coniferous trees were somewhat abundant, especially the former; Palms also, related to the *Nipa*; while the Cotton- and Orange-trees had their analogues; and with them also occurred a proteaceous plant, *Petrophylloides*, related to a group characteristic of the vegetation of Australia.

The third lecture continues in descending order the lower London Tertiaries, that variable and irregular group of marine, freshwater, and estuarine origin, known as the Basement-bed, Woolwich and Reading series, and Thanet Sands;—the latter forming "underneath London and the adjacent districts a large and important water-bearing stratum,—that which supplies all the early and many of the later Artesian wells," the origin and principles of which are fully explained (p. 68).

This portion concludes with certain theoretical considerations, in which the author dwells upon the probable extent of the old Chalk area,—the seas, land, islands, and climatal conditions of the older Tertiary and London-clay periods, and the subsequent changes in the physical geography of the district around London.

Originally given as lectures, and not intended at first for publication, Mr. Prestwich naturally avoided any details that would be uninteresting to his audience (which can be readily appended in any future edition); his intention, which is successfully carried out, being to interest his hearers in the general geological principles, and

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author of this valuable monograph should not have fully availed himself of some of the fine specimens of fossil Crustacea from the London Clay in the Hunterian Collection of the Royal College of Surgeons, as additional objects of illustration for his memoir,—specimens collected at so early a period, and evincing the interest which the great comparative anatomist took in this portion, as he did in every other, relating to the fossil relics of past creations.

to stimulate them to further inquiries, "the object of which is to interpret truthfully and earnestly those records of past creations, the memorials of which exist within our reach, although buried and obscured in the ground beneath our feet."

Besides the illustrations of fossils and diagrams, the work is accompanied with an outline geological map of the neighbourhood of London, and section of the Drift and London Tertiary strata.

A Catalogue of the Lepidopterous Insects in the Museum of the Hon. East India Company. By THOMAS HORSFIELD, M. and Ph. D., F.R.S., Keeper of the Company's Museum, and FREDERIC MOORE, Assistant. Vol. I. Printed by Order of the Court of Directors. London, 1857. 8vo, pp. v and 316, and 18 Plates.

The recent opening of the very extensive and splendid additional Museum in the East India House, and the publication of the volume before us, at a time when the Hon. Company itself is overshadowed by so dense a political cloud, are circumstances which speak volumes for the energy of the Company and the activity of its servants.

Thirty years ago, the veteran naturalist whose name first appears on the title-page of the work above noticed, published two Parts of a Treatise on the Lepidopterous Insects of Java, the materials for which had been collected by himself, comprising a truly valuable series of illustrations of the transformations of a great number of highly interesting species of butterflies. The plan on which the work was published, we are now told by the author, could not ensure public support. It was in fact far too costly and elaborate, and consequently the publication of it was discontinued after two Parts had appeared in 1828 and 1829. The materials, however, which those two numbers contained were of the utmost value for a true classification of the Order, consisting as they did not only of truthfully executed illustrations of the transformations, but also of elaborate analyses of the perfect insects themselves. Entomologists therefore who felt an interest in the subject beyond the mere possession of a cabinet of specimens, regretted the discontinuance of the work, and the non-publication of the abundant materials remaining in the portfolios of the author. Time, however, wore on, and the system of Catalogues published by the Trustees of the British Museum induced the Hon. Company to commence the publication of a similar series of Catalogues of the contents of their Museum. Several of these have appeared, and now we have before us the first volume of the Entomological Series, in which the whole of the Eastern Diurnal and Crepuscular Lepidoptera, six hundred and fifty in number, are catalogued, accompanied with coloured illustrations of their transformations, occupying twelve crowded plates, together with six plates filled with figures of new species. Not only are the whole of Dr. Horsfield's own collection of drawings of the transformations of the Javanese species of these two divisions now published, but also several valuable series of similar drawings of continental Indian species by A. Grote, Esq., Lady

Isabella Rose Gilbert, Mrs. Hamilton, and Capt. Mortimer Slater, and of Ceylonese species by E. L. Layard, Esq.

As in his former work, Dr. Horsfield here expresses his conviction that the transformations of Lepidoptera afford the chief clue to the discovery of the natural system; and in his introductory remarks he has paid a just compliment to the 'Systematisches Verzeichniss' of the Theresianer, whose maxim, "ein Auge auf den Schmetterlinge, das andere auf die Raupe," ought never to be lost sight of by Lepidopterists. In like manner, he avows his continued adherence to the circular and quinarian system of MacLeay, supported as it has been by Gray in Mammalia, Vigors and Kaup in Birds, De Haan in Crustacea, and Fries in Fungi.

As, however, in a collection from a territory of limited geographical extent, large chasms remain to be supplied from other localities, Dr. Horsfield "desires that it may be distinctly understood, that it is not his purpose to give an illustration of MacLeay's particular system; his object being to contribute a fragment towards a future enterprise of a more qualified entomologist." The attempt, indeed, to work out the MacLeaian system in such a catalogue as that now before us, would have occupied not only too much space, but also far too much time at Dr. Horsfield's very advanced age.

The Diurnal Lepidoptera are arranged in five Stirpes, from the supposed analogical resemblance of their larvæ with the five Orders of Ametabola according to the system of MacLeay:—1. Those with vermiform larvæ, containing the family Lycænidæ. 2. Those with Chilognathiform or Iuliform larvæ (Pierides and Papilionides). 3. Those with Chilopodiform or Scolopendriform larvæ (Nymphalidæ). 4. Those with Thysanuriform larvæ, having the head and tail furcate, containing the Morphides, Hipparchiides, and portion of the Nymphalidæ; and 5. Those with Anopluriform larvæ, comprising the Erycinidæ, Hesperiidæ, and the genus *Nyctalemon*. The Sphingides are comprised in five Stirpes: of the first, containing *Castnia* and *Euschemon*, there is no Indian representative; the second is typified by *Sesia* and *Macroglossa*; the third by *Smerinthus*; the fourth by *Acherontia* and *Sphinx*, and the fifth by *Deilephila* and *Choerocampa*; the Zygænidæ and Trochiliidæ being removed to the Nocturnal division.

We are not disposed to enter into any extended criticism of the classification proposed above, but shall simply state our opinion that the group or class Ametabola of MacLeay, involving the analogical classifications founded thereupon, is entirely faulty in its construction; that the Morphides and various Nymphalideous genera placed in the Thysanuriform section are more naturally allied to the Chilopodiform group; that *Adolias* even affords perhaps as good an instance of analogy as could be desired with a Chilopod genus, namely *Scutigera*; that the Erycinidæ and Hesperiidæ belong to totally different types; that *Nyctalemon* is a Heterocerous genus; that the 2nd, 3rd, 4th and 5th Stirpes of the Sphinges are far too closely allied together to be considered separately as of equal rank with *Castnia*; and that *Euschemon* belongs to the Diurna.

We must not conclude without referring to the excellent observations on the divisions proposed in the great genus *Papilio* by Dr. Horsfield, nor to the very careful manner in which the synonymy of the old and the description of the new species have been worked out by Mr. Moore. We could have wished that the classical system of giving short Latin characters of each species had been adopted, as we know by experience how apt entomologists are to overlook descriptions of species written only in the vernacular language of authors of other countries. We trust, in conclusion, that this volume is only the precursor of several others, in which the remainder of the Order will be described. We know that there are ample materials for such additional volumes, and we trust that Dr. Horsfield will be spared to see their publication.

General Report upon the Zoology of the several Pacific Railroad Routes. Part I. *Mammals.* By SPENCER F. BAIRD. 1 vol. 4to. Washington, 1857.

The contributions already made to our knowledge of the Fauna of North America by the zoological appendices to the Reports of various Surveys and Explorations ordered by the Government of the United States, are neither few nor unimportant. The accounts of expeditions to the Red River of Louisiana, the Great Salt Lake of Utah, and the Zuni and Colorado Rivers, all contain materials worthy of much attention, and especially calculated to throw light upon the theory of the distribution of animal life in the North American continent. And in the Reports of the recent U. S. Astronomical Survey in the Southern Hemisphere, and of Commodore Perry's Japan expedition, we have evidence that the American Government is sufficiently 'catholic' in its promotion of scientific investigation not to refuse assistance in extending our knowledge of the zoology of other parts of the world besides those immediately subject to its sway. The seventh volume of the 'Reports of Explorations and Surveys to ascertain the most practicable and economical route for a Railroad from the Mississippi to the Pacific Ocean, made under the direction of the Secretary of War in 1853–56,' the title of the first part of which is given above, promises to bring still greater additions to our knowledge of North American Zoology than any of the previous publications. This first part only embraces the *Mammalia*; but if the Birds, Reptiles, Amphibians, Fishes, and other orders of organized beings are treated of in the same way, the result will be a complete and very interesting *résumé* of the zoology of this portion of the globe. The numerous different surveying parties which were employed on the proposed Pacific railway-routes, amassed a very large quantity of materials for scientific research, which were all transferred by the U. S. Government to the guardianship of the Smithsonian Institution at Washington. The energetic Assistant-Secretary of that establishment, Professor Baird—than whom no one could be found better qualified for the task—has himself undertaken to work out the specimens of Mammalia collected. The same gentleman, together

with Mr. Cassin, the well-known ornithologist, will take the Birds. The Reptiles will probably be assigned to Prof. Girard or Dr. Hallowell, and the other Orders to the naturalists best qualified to deal with them. This is an excellent method—putting the "right man in the right place," instead of setting a man learned in one 'ology to work at another, according to a plan which we have before now seen adopted in this country.

The present volume, which is the first of the series, and is entirely from the pen of Professor Baird, gives a general account of all the species of Mammals collected by the various aforesaid expeditions, noticing at the same time, in their proper places, all those known to inhabit the continent of North America. It contains the technical descriptions of the families, genera, and species, remarks necessary to show their places in the system, their synonymy, and "an enumeration of all the different specimens collected." Other volumes will be devoted to the zoology of the separate expeditions, and enter more into particulars concerning habits, manners, &c. We beg to call particular attention to the plan of stating the exact locality of every specimen collected here adopted, which is most useful for working out the theory of geographical distribution,—a subject now attracting so much attention.

"The time is now passed," says a recent distinguished writer on natural history, "when the mere indication of the continent whence an animal had been obtained could satisfy our curiosity; and the naturalists who have an opportunity of ascertaining closely the particular circumstances under which the animals they describe are placed in their natural home, are guilty of a gross disregard to the interests of science when they neglect to relate them. Our knowledge of the geographical distribution of animals would be far more extensive and precise than it is now, but for this neglect; *every new fact relating to the geographical distribution of well-known species is as important to science as the discovery of a new species.*"

To this volume there are likewise attached indices of the particular localities mentioned, of the authorities referred to, of local names and of scientific names,—all most useful and valuable appendages to the work.

The total number of species of Mammalia now recognized by Professor Baird as inhabiting the North American continent amounts to 220, of which he has himself examined specimens, whilst there are 35 others more or less doubtful. This is a vast increase,—no less than 70 species having been added as new to Audubon and Bachman's list, the greater part being the result of these expeditions. This, too, is exclusive of *Cetacea*, *Pinnipedes*, and Bats, none of which are touched upon in the present treatise. The first two of these groups can hardly be said to belong to the land-fauna of North America; but we must allow something for the *Chiroptera*, to arrive at the true number of North American Mammalia. Major John Leconte in his paper in the seventh volume of the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' which is, we believe, the only modern authority on North American Bats, men-

tions fifteen species only as recognized by himself. This, however, raises the number of positively recognized Mammalia belonging to the North American fauna to 235, excluding Pinnipeds and Cetaceans.

Taking the several groups in the order in which they stand in Professor Baird's arrangement, we have first the *Insectivora*, containing Shrews and Moles,—together 26 species. Among these is a very remarkable (if reliable) addition to the American fauna in the shape of a second species of *Urotrichus*, a genus of *Talpidæ* hitherto embracing but one member, found in Japan. We may, however, notice the fact that but one imperfect specimen of this animal appears as yet to have been obtained; and an accurate comparison of it with the Japanese *Urotrichus* is requisite, before animals coming from localities so different can be recognized without doubt as the two only members of the same peculiar genus.

Of the *Carnivora* the large number of 46 are recognized as North American, made up of 9 *Felidæ*, 8 *Canidæ*, the *Bassaris astuta* of Mexico and Texas—sole representative of the family *Viverridæ*, 23 *Mustelidæ*, and 5 species of *Ursidæ*. This is exclusive of several species established by previous writers, but which Prof. Baird has, with much judgment, reduced to the rank of local varieties—such as the *Canis nubilus* of Say, and the *Felis maculata* of Horsfield and Vigors.

The *Marsupialia* in the northern portion of the American continent are represented by two species of the genus *Didelphis*, commonly known as 'Opossums.'

The Rodents are, again, extremely numerous. In the first place, the Squirrels of different genera, with the Marmots (so called), Prairie-dogs, and Beavers, make up no less than 41 members of the family *Sciuridæ*. The *Saccomyidæ*, or Pouched Mice, which, in accordance with Mr. Waterhouse's views, but in opposition to those of Professor Brandt, are grouped together, next follow, and are considered by Professor Baird as "one of the most natural families of Rodentia, although the component genera have been widely separated by different authors. In the external cheek-pouches," he remarks, "there is no other family which exhibits any approach to it. These open outside of the mouth, and are of variable depth and lined with short hairs to the bottom. When inverted and dried, they look like sacs on each side of the head." Of these peculiar animals, the range of which is confined to Northern America and the Antilles, 21 species are enumerated, as appertinent to the fauna of the United States. Two Porcupines of the North American form *Erethizon* are the only *Hystricidæ* met with in this part of the world; but there are no less than 52 *Muridæ* of varied forms; and 13 Hares and Rabbits, with a single *Lagomys*, give 14 species of the family *Leporidæ*. Altogether, therefore, the order Rodentia in North America, as elsewhere, plays a most important part as regards numbers, embracing 130 species—more than half the whole number of Mammals known to occur.

The order *Edentata* is represented within the limits of the United States by a single straggling species of Armadillo, which occurs

within the confines of Texas, and is somewhat doubtfully referred to the *Dasypus novem-cinctus* of Linnæus.

The Pachyderms have also but a single representative, the Collared Peccary, *Dicotyles torquatus*, which, it is remarked, "has a much wider range in North America than is supposed by European systematic writers. It not only occurs through Mexico, but even as far north in the United States as the Red River of Arkansas, in latitude 34°."

The Ruminants, however, muster more strongly, being better adapted for residence in the temperate regions of the North. In the first place, we have the Moose, *Alce americana*. Then two species of Reindeer are admitted under the titles *Rangifer caribou* and *R. grœnlandicus*, though it is allowed that their distinctness is questionable. It is highly desirable that accurate investigations should be made as to the difference of these animals *inter se*, and with the European *R. tarandus*, which is said to present somewhat corresponding variations. The genus *Cervus* and its subdivisions are represented by no less than six species, which are said to be all truly different, although the distinctions between *Cervus virginianus* and *C. leucurus*, and *C. macrotus* and *C. columbianus* require some further elucidation. North America contains only two Antelopes, the 'Prong-horn' (*Antilocapra americana*), and the so-called 'Mountain-goat' (*Haplocerus montanus*), and a single Sheep, the well-known Big-horn of the Rocky Mountains, *Ovis montana*. The Musk-ox of the Arctic regions (which, however, does not occur within the limits of the United States), and the Buffalo, *Bison americanus*, conclude the catalogue of North American Ruminants, making up a total of 14 animals of this order. What a contrast in this respect does North America present to Africa, where more than 60 species of Antelopes alone are already known to occur, and the list is daily increasing! For, though we may laugh at Buffon's theory as to the animals of America being merely degraded forms of those of the Old World, there can be no question that the 'Great Continent' is far more productive of animal forms of a more highly organized structure, and of a nature more adapted to meet the various wants of mankind.

Table of Genera of North American Mammalia, according to Professor Baird.

Order.	Family.	Genus.	Species examined.	Species not examined.
I. RAPACIA	1. Soricidæ	1. Neosorex....	1	
		2. Sorex	12	4
		3. Blarina	7	
	2. Talpidæ......	4. Scalops	4	1
		5. Condylura ..	1	
		6. Urotrichus ..	1	
			26	5

Order.	Family.	Genus.	Species examined.	Species not examined.
Brought forward			26	5
	3. Felidæ	7. Felis	5	
		8. Lynx	4	
	4. Canidæ	9. Canis	2	
		10. Vulpes	6	
	5. Viverridæ	11. Bassaris	1	
	6. Mustelidæ	12. Mustela	2	
		13. Putorius	10	1
		14. Gulo	1	
		15. Lutra	2	
		16. Enhydra	1	
		17. Mephitis	5	1
		18. Taxidea	2	
	7. Ursidæ	19. Procyon	2	1
		20. Ursus	3	
II. Marsupiata	8. Didelphidæ	21. Didelphis	2	
III. Rodentia	9. Sciuridæ	22. Sciurus	12	6
		23. Pteromys	4	
		24. Tamias	4	
		25. Spermophilus	14	1
		26. Cynomys	2	
		27. Arctomys	2	2
		28. Aplodontia	1	
		29. Castor	1	
		30. Castoroides	1	
	10. Saccomyidæ	31. Geomys	5	
		32. Thomomys	7	1
		33. Dipodomys	3	2
		34. Perognathus	6	
	11. Muridæ	35. Jaculus	1	
		36. Mus	4	
		37. Reithrodon	4	1
		38. Hesperomys	15	1
		39. Neotoma	6	
		40. Sigmodon	2	
		41. Arvicola	16	11
		42. Myodes	3	
		43. Fiber	1	
	12. Hystricidæ	44. Erethizon	2	
	13. Leporidæ	45. Lepus	13	2
		46. Lagomys	1	
IV. Edentata	14. Effodientia	47. Dasypus	1	
V. Pachydermata	15. Suidæ	48. Dicotyles	1	
VI. Ruminantia	16. Cervidæ	49. Alce	1	
		50. Rangifer	2	
		51. Cervus	6	
	17. Cavicornia	52. Antilocapra	1	
		53. Aplocerus	1	
		54. Ovis	1	
		55. Ovibos	1	
		56. Bos	1	
			220	35

PROCEEDINGS OF LEARNED SOCIETIES.

BOTANICAL SOCIETY OF EDINBURGH.

February 11, 1858.—Dr. Seller, President, in the Chair.

The following papers were read :—

1. "Remarks on the Suborder *Orthotricheæ*," by Benjamin Carrington, M.D.

Dr. Carrington pointed out the futility of founding genera on characters depending upon the peristome alone, which he considered a non-essential organ, and, like the number of petals in flowering plants, only useful as affording specific characters. He also drew attention to the importance of studying more carefully than had hitherto been done, the limits of variation of individual species, for which purpose the bryologist should acquaint himself with the plant in its different stages of growth, and its appearance on certain soils, and in humid or dry and exposed localities.

2. "Notes of a Botanical Trip with Pupils to Coldstream and Norham, in July 1857," by Prof. Balfour.

3. "Remarks on the Distribution of Plants in the Northern States, Canada, and the Hudson's Bay Company's Territories, &c.," by Dr. George Lawson. Part 1.

Dr. Lawson alluded to the favourable conditions afforded by the physical characters of the North American continent for tracing the horizontal range of vegetation. Having recently received extensive collections of North American plants, he proposed to bring before the Society some of the more interesting facts which they served to illustrate. The Arctic forms were first noticed. A collection made by Captain Rae during his last boat-voyage in search of Sir John Franklin, contained only one Fern, the rare *Lastrea fragrans* (*Polypodium fragrans*, Linn.), from Repulse Bay. Mr. Moore observes, in a letter to Dr. Lawson, that the North American *Allosorus gracilis* is the *Pteris Stelleri* of Amman, *Allosorus Stelleri* of Ruprecht, which name takes precedence. So that it spreads from North America through Siberia to India, whence Dr. Hooker has it.

4. "Notice of the Produce of the Olive Crop in the Island of Corfu during the past Season," by Mr. Mackenzie, of Corfu.

5. "Remarks on a species of *Loranthus*, and Measurements of Tree-Ferns in Australia," by Mr. Thomas Cannan.

Mr. Cannan has sent seeds of a parasitic species of *Loranthus*. They are attached to branches, and some of them are beginning to germinate. It is said to produce showy flowers, and to grow on almost any tree with a smooth bark. It grows well on some of the trees introduced into Melbourne gardens, such as the English Oak and Elm, and the common Laburnum. It attaches itself to the native *Eucalypti*, and is propagated by means of birds, which scatter the seeds. Mr. Cannan also sends the following measurements of Tree-ferns met with during his Australian rambles :—No. 1. From

the ground to the top of some upright fronds, 18 feet; from the ground to the crown, clean stem, 13 feet; girth at the bottom of the stem, 8 feet; girth 5½ feet from the ground, 4⅓ feet; length of fronds, 10–12 feet. About halfway from the ground this plant is divided into two stems, each stem supporting a beautiful head. No. 2. Length of clean stem, 18 feet; girth at the bottom, 7 feet; girth 5 feet from the ground, 5⅓ feet; length of fronds, 5 feet. No. 3. Clean stem from the ground to the crown, 20 feet; divides into two stems, one measuring 11 and the other 8 feet; girth where the stem divides, 5 feet; length of fronds, 6 feet. No. 4. Length of stem, 20 feet; girth at bottom, 6 feet; girth 6 feet from the ground, 4 feet; length of frond, 5–6 feet.

6. "Notice of Plants collected in the Isle of Skye," by Dr. John Alexander Smith and Dr. Gilchrist.

Dr. Smith, while residing at Armadale Castle, Skye, in October and November last, observed a few interesting plants in the neighbourhood; *Sticta Pulmonaria* was in great abundance and in fine fruit on the trees. *Himanthalia lorea* formed large patches on the rocks along the shore.

ZOOLOGICAL SOCIETY.

January 12, 1858.—Dr. Gray, F.R.S., V.P., in the Chair.

A Monograph of the Genus Nyctophilus. By Robert F. Tomes.

The characters of the present genus were first briefly given by Dr. Leach in a communication to the Linnæan Society in March 1820, which was not, however, published until 1822.

The paper is entitled, "The characters of seven genera of Bats with foliaceous appendages to the nose;" the seven genera being, *Artibeus, Monophyllus, Mormoops, Nyctophilus, Megaderma, Vampyrus,* and *Madateus.*

From the manner in which *Nyctophilus* is here associated with the other genera, it seems not unfair to assume that Dr. Leach regarded it as more or less closely affined to them; and they, with the exception perhaps of *Mormoops,* all appertain to the *Phyllostomidæ.*

M. Temminck, in his monograph of the genus, gives it as his opinion that it may properly be placed between *Rhinolophus* and *Nycteris*; and Dr. Gray, although arranging it amongst the *Vespertilionidæ,* or Simple-nosed Bats, nevertheless places it immediately after *Nycteris,* which he considers as belonging to the *Vespertilionidæ* also. But *Nycteris* is thought by some zoologists to have some affinity with the *Rhinolophidæ,* and my own repeated examinations have convinced me that it is simply a modification of *Rhinolophus.*

From this it would seem that the genus *Nyctophilus* has always been considered by those who have studied the subject as either belonging to the *Istiophori* or Leaf-nosed Bats proper, or as having some affinity with them.

It will be the purpose of the present paper to show that the genus

Nyctophilus is not more remote from the genus *Vespertilio*, than are the genera *Barbastellus* and *Plecotus*, and further to show that it is as intimately allied to the last of these as to any other genus.

In the course of a very careful study which I have made of the crania of a number of examples, I have detected one or two errors in the account given of the dentition, both by Dr. Leach and M. Temminck. These will be pointed out in their proper place.

Fam. Vespertilionidæ.

Genus Nyctophilus.

The top of the head is but slightly elevated, not more so than in *Plecotus auritus*, and the muzzle is relatively of about the same length and substance as in that species. The forehead, between the eyes, is a little depressed, producing a slight hollow somewhat as in the genus *Taphozous*, but in a much less degree. The nose-leaves are simple ; the first is placed immediately above the nostrils ; it is transverse, and there is a kind of thickened line or ridge passing from the lower margin of the nostrils on each side, and uniting with its outer boundaries. The upper margin of this leaf is straight and even. The second nose-leaf is placed at a greater distance from the first, than the first is from the nostrils. It is also transverse, but is higher in the middle than at the sides, is much thicker in substance, and is thickly clothed with short bristly hairs. The nostrils are small and not prominent, nearly round when seen in front, but with a backward narrow extension nearly reaching to the outer margin of the first nose-leaf, when examined laterally. The ears are large,—about one-fourth longer than the head,—regularly ovoid, and one-fourth longer than wide. They are united at their bases by a piece of transverse membrane across the top of the head, as in *Plecotus*. This membrane is not attached to the inner edge of the ears, but to their hinder surface, so as to leave the margins free. It extends for nearly one-third of the length of the ear. The tragus is short and broad, but rather thin and membranous. Quite at its root it is narrow ; but it suddenly attains its full breadth, and taking at once a vertical direction, tapers somewhat unevenly to a narrow but rounded point. The outer margin, near to the base, is the most prominent part ; it is rounded, and in some individuals with one or two projecting points. Above this prominence, about the middle of the outer margin, it is slightly hollowed or scooped out, and the inner margin has a corresponding prominent outline immediately opposite to this hollow. The tip is much narrower than any other part of the tragus, but it is nevertheless quite rounded. Although the general form of the tragus is pretty similar in all the examples I have seen, yet it appears liable to greater variations than is usual in most species of *Vespertilionidæ*. For instance, in some examples the margins, although possessing a somewhat undulating outline, are nevertheless smooth ; whilst in others the whole of the outer one is finely crenulated ; again, the tip is sometimes curved a little inwards, but in others it is quite straight.

The organs of flight so exactly resemble those of the genus *Vespertilio*, that it is needless to make further remarks on them, excepting to mention that the wing-membranes spring from the base of the toes.

All the hinder extremities may be similarly dismissed.

The cranium in its general appearance resembles that of several species of *Vespertilionidæ*, and so nearly, that it would be easy at first sight to confound them. The *Serotine Bat* of Europe, the *Scotophilus Carolinensis* and *Vespertilio velatus* of America, but more especially a species inhabiting the same country as the *Nyctophilus*, viz. *Vesp. Tasmaniensis*, may be cited as species, the crania of which are most like that of *Nyctophilus*.

The cerebral portion is but little elevated above the facial portion, and it rounds off but very little from the vertex to the occiput, above the foramen of which is a moderately developed occipital crest, varying considerably in different species. There is the same deep notch in the anterior part of the skull which is observable in *Vespertilio* and *Scotophilus*, caused by the imperfect development of the intermaxillary bones. Immediately above this notch is a rather broad but shallow depression, occupying the position of the nasal bones. It is as deep from side to side as from before to behind; but there is one point where it runs a little deeper than elsewhere, just at the hinder ends of the nasal bones. Precisely the same kind of depression occurs in the cranium of the *Barbastelle Bat*. But in *Nyctophilus* the depression is rendered more conspicuous by the somewhat more elevated position of the *malar processes*.

The zygomatic arches are not very much arched outwards, less so than in many species of *Vespertilio*, such as *V. Nattereri*, but quite as much so as in *Plecotus*. The orbits extend rather markedly forward, in one species almost to the root of the canine tooth, whilst the palatal portion of the maxillary bones reaches as far back as usual, so as to give a somewhat greater extent of *floor* than ordinary to the orbit. The bony palate extends backwards almost to the condyloid fossa; but its hinder margin is so much scooped out that its middle does not much exceed the middle of the zygomatic arch, in a backward direction. In this respect it resembles the same part in *Plecotus*; in *Barbastellus*, *Vespertilio*, and *Scotophilus* it is doubly emarginate.

The teeth of the upper jaw, when seen from below, present two straight lines, somewhat diverging towards their hinder ends, just as in *Vesp. velatus*, *Scot. serotinus*, *Scot. Carolinensis*, and *Barbastellus*. The two incisors are the only teeth which deviate from these lines, being placed more inward than the canines, which terminate them. Seen laterally, the upper teeth have a curved outline, bending slightly upward from the root of the zygoma to the most anterior part of the intermaxillary bone. The exact form of the lower margin of the maxillary and intermaxillary bones is tolerably well indicated by the range of the teeth, as just stated; and it may be here remarked, that this is a point worthy of attention in the classification of the *Vespertilionidæ*.

The lower jaw so closely resembles that of the generality of the *Vespertilionidæ*, that I consider it only necessary to state that it appears to resemble the same part in *Scot. Noctula* as closely as in any other species, differing only in having the coronoid process a little more elevated.

Commencing the description of the teeth themselves with the upper incisors, I find them to be two in number, short and conical, and furnished with a distinct *cingulum*, which passes into a point on the hinder side of the tooth, well defined in some species, but scarcely observable in others. In those in which it does occur, it constitutes a peculiarity quite distinct from the bifid incisors of some species, such as the *Barbastelle*, where the *cingulum* is left entire, and the apex of the tooth appears as if cleft.

The canines are somewhat shorter and relatively a little stouter than in *Vespertilio* and *Plecotus*, and also shorter but not stouter than in *Scotophilus*. The next tooth, the only premolar in the upper jaw, and the following three true molars, have the form and proportions so usual in the *Vespertilionidæ*, that they require no special notice, excepting to state that the posterior one is a little smaller than is generally observable.

In describing the teeth of the lower jaw, two errors which have been made respecting their number require correction. Dr. Leach states that the lower incisors are six in number, and M. Temminck, describing afterwards from the same specimen, could find but four. After diligently examining a considerable number of skulls, I have satisfied myself that the account given by Dr. Leach is correct, for in no instance can I discover less than six lower incisors; but in two examples the outer one on each side is wholly hidden by the one next to it, so that unless the skull be carefully cleared of the investing membranes, it would be extremely difficult to see more than four of these teeth; hence has probably arisen the error.

They are cylindrical at the base, and for a considerable part of their length; but expand into flattened fan-shaped summits, having three lobes or points. The canines are of the usual form, and are not, as has been stated, furnished with a posterior lobe or spur. What has been mistaken for a part of the canine, is in fact a small and pointed premolar, placed so close behind it as to seem continuous with it. On instituting an examination of the canines, and comparing them with those of other species, I find that the *cingulum* is not so much developed posteriorly as in many others. In the common *Noctule*, for instance, although the canine presents only a mere trace of thickening of the base anteriorly, it nevertheless passes into a small but distinct spur or point behind. The small anomalous premolar alluded to is situated in the same line with the teeth, between which it is placed in such a manner as to be equally visible from within or without. Its form is conical. The next tooth is also regularly conical, and furnished with a broad basal collar or *cingulum*; after this come the three true molars, presenting the form common to all the *Vespertilionidæ*.

The dentition of the genus may be given as follows; and as that

of all the species is numerically similar, it will render repetition unnecessary.

Dentition.—In. $\frac{1\cdot1}{6}$; C. $\frac{1\cdot1}{1\cdot1}$; P. M. $\frac{1\cdot1}{2\cdot2}$; M. $\frac{3\cdot3}{3\cdot3}=\frac{12}{18}$.

1. Nyctophilus Geoffroyi, Leach.

Nyct. Geoffroyi, Leach, Linn. Trans. xiii. p. 73, 1820–22; Less. Man. p. 86, 1827; Fisch. Synop. Mamm. p. 135, 1829; Temm. Mon. ii. p. 47, 1835–41; Wagn. Supp. Schreb. i. p. 442, 1840; Less. Nouv. Tabl. Règn. Anim. p. 33, 1842; Schinz, Synop. Mamm. i. p. 217, 1844.

Of the four species treated of in the present monograph, the first, from its size, is unquestionably the one on which Dr. Leach established the genus.

The original description in the Linnæan Transactions is much too vague to discriminate the exact species with certainty; but M. Temminck having become possessed of the original specimen, and given a more detailed description of it, I am enabled to determine with certainty which of the species here given is the true *N. Geoffroyi.*

I intend, therefore, first to give a description of this species, and then to point out briefly what I consider sufficient differences to constitute three other species. One of these has indeed been repeatedly described as a *Vespertilio—Vesp. Timoriensis*; but it is strictly a *Nyctophilus,* as I have ascertained by the examination of the original specimen in the Paris Museum.

The face is moderately hairy, the hairs being pretty regularly scattered, but a little thicker on the upper lips and on the second nose-leaf than elsewhere. Immediately over the eye is a small tuft of bristle-like black hairs, and a similar one near the hinder corner of the eye. At the angle of the mouth a few similar hairs may be observed. The fur of the back extends to a very trifling extent on to the interfemoral membrane, but all the other membranes are perfectly naked, and of a dark brown colour, as are also all the other naked parts, with the exception of the tragus and the contiguous parts of the inside of the ear, which are brownish-yellow.

The fur of the body is rather long, thick, and very soft.

On all the upper parts it is conspicuously bicoloured, black for nearly two-thirds of its length, the remainder being olive-brown, of which the extreme tips are rather the darker portion. On the membrane uniting the ears the fur is uniform yellowish-brown.

The fur of the throat and flanks is uniform brownish-white, that of the latter being sometimes more strongly tinted with brown. All the remaining under-parts have the fur markedly bicoloured, black at the base, with the terminal third brownish-white, varying considerably in purity of colour in different individuals.

In the following table of dimensions, the first column refers to a specimen in Mr. Gould's collection, very kindly lent by him for my use, and from which the foregoing description has been taken: it is labelled "Albany, King George's Sound, May 19th, 1843." The

dimensions in the two other columns have been taken from specimens in my own collection, and are also from Western Australia, but the exact locality unknown.

The comparative description and measurements of the crania of this and the other species will be given in a collected form appended to the description of the species the last on the list, so as to render their differences more readily apparent:—

	1.		2.		3.	
	in.	lin.	in.	lin.	in.	lin.
Length of the head and body (about)..	1	8	2	0	1	9
——— of the tail	1	4	1	5	1	5
——— of the head	0	7½	0	8	0	8
——— of the ears	0	9	0	9	0	9
——— of the tragus	0	2½	0	3	0	3
Breadth of the ears	0	6	0	6½	0	7
——— of the tragus	0	1¼	0	1¼	0	1½
Length of the fore-arm	1	4	1	4	1	4
——— of the longest finger	2	4	2	6	2	6
——— of the fourth finger..........	1	9	1	10	1	10
——— of the thumb	0	2¾	0	3	0	3½
——— of the tibia	0	7	0	7½	0	7
——— of the foot and claws	0	3	0	3½	0	3¼
——— of the os calcis	0	5	0	6	0	6
Expanse of wings, about	9	0	9	7	9	9

2. Nyctophilus Timoriensis.

Vesp. Timoriensis, Geoff. Ann. du Mus. viii. p. 200. t. 47, 1806; Desm. Mamm. p. 146, 1820; Fisch. Synop. Mamm. p. 118, 1829; Temm. Mon. ii. p. 253, 1835–41; Wagn. Supp. Schreb. i. p. 520, 1840; Schinz, Synop. Mamm. i. p. 175, 1844.

Vesp. Timoriensis?, Temm. Mus. Leyd.

Plecotus Timoriensis, Less. Man. p. 97, 1827; Is. Geoff. Guérin Mag. de Zool. 1832; Less. Nouv. Tabl. Règn. Anim. p. 23, 1842.

The forms of this species are so similar to those of the last, that it is needless to enter at greater length into details of description than is necessary to point out the differences between the two.

In all the specimens I have been able to examine, viz. the original one in the Paris Museum, and three others collected in Australia by Mr. Gould, the ears are strongly sulcated, even more so than is observable in the *Plecotus auritus,* whilst in the preceding species they are very faintly, if at all, so marked; and instead of the small tufts of bristle-like hairs about the eyes, the present species has a tolerably regular series of similar ones fringing the eyelids. Again, the cranium has so strongly marked a sagittal crest as to be easily detected in the mounted specimens, whereas in *N. Geoffroyi* it is so feebly developed that no trace can be discovered, unless the skull be extracted and carefully cleaned.

But the great difference in the size of the two animals is alone sufficient to distinguish them, the one being only 9 inches in expanse of wings, whilst the other attains fully 13 inches; nearly as great a difference as exists between the *Pipistrelle* and the *Noctule* Bats.

The fur of the upper parts is bicoloured, nearly black at the base, with the terminal half dark sepia-brown; that on the top of the head and on the membrane uniting the ears, unicoloured, and paler.

Beneath, the fur has the basal half nearly black, the remainder being light brown, palest on the throat, on the middle of the belly, and on the pubes. On the shoulder of one example from "Perth, Western Australia," is a patch of brownish rust-colour, but it does not occur in the other examples.

Although the original specimen of this species is reported to have been received from Timor, I am inclined to believe that there may have been some mistake respecting its locality. Among a great number of Bats from that island contained in our museums and that of Leyden, representatives of this genus do not appear; but specimens absolutely identical with the original in the Paris collection have been obtained by Mr. Gould in Western Australia; and I have noted one in the Leyden Museum, also from Australia, but without any precise indication of locality.

The following dimensions have been taken from specimens collected by Mr. Gould, the first being the one from Perth, Western Australia:—

	1.		2.	
	in.	lin.	in.	lin.
Length of the head and body, about ..	3	0	2	4
——— of the tail	1	$10\frac{1}{2}$	1	10
——— of the head	0	10	0	10
——— of the ears	0	10	0	10
——— of the tragus	0	$3\frac{1}{2}$	0	$3\frac{1}{2}$
——— of the fore-arm	1	9	1	9
——— of the longest finger	3	4	3	2
——— of the fourth finger	2	4	2	5
——— of the thumb..................	0	$4\frac{1}{2}$	0	4
——— of the tibia	0	9	0	9
——— of the foot and claws	0	5	0	5
——— of the os calcis	0	7	0	8
Expanse of wings, following the phalanges	13	6	12	9

3. Nyctophilus Gouldi, n. s.

The present species is intermediate in size between the two last, and at first sight might be taken either for a small individual of *N. Timoriensis*, or a large one of *N. Geoffroyi*; or these two might be regarded as the large and small varieties of the same species, and the present one as the intermediate or connecting link. This opinion I was at first disposed to entertain; but after the examination of a greater number of examples, and more especially after extracting

a good number of their crania, I became convinced that they were all specifically distinct.

The shape of the head, face and ears does not differ materially from that of the same parts in the two preceding species; the only perceptible difference beyond that of size being in the somewhat greater elevation of the top of the head. As in *N. Timoriensis,* the ears are strongly sulcated, and it bears a general resemblance to that species in the quality and colouring of the fur.

The fur of the whole of the upper parts is very distinctly bicoloured: it might almost be called tricoloured; the basal half greyish-black, and the terminal half grey-brown, with the tips browner. On the rump the brown colour is rather more conspicuous than on the fore part of the back. The basal part of the upper surface of the interfemoral membrane is a little hairy in some specimens, but in others this is not observable.

On the whole of the under-surface the fur is strongly bicoloured, nearly black at the base, with the terminal third buffy grey. On the pubes the dark colour at the base of the fur is reduced to a small quantity, and it is almost wholly of the buffy-white colour.

Young examples not having the wing-joints completely ossified, differ only in being somewhat smaller, and in having the fur less bright; but it is nevertheless distinctly bicoloured, and when obviously immature they are still of greater size than adult examples of *N. Geoffroyi.*

In the table of dimensions, column No. 1 refers to a female specimen from Mr. Gould's collection from Moreton Bay; No. 2 to a male from the same locality; and No. 3 to a specimen also collected by Mr. Gould at Bathurst.

	1.		2.		3.	
	in.	lin.	in.	lin.	in.	lin.
Length of the head and body, about ..	1	11	2	0		
——— of the tail	1	10	1	8		
——— of the head	0	9	0	9		
——— of the ears	1	0	0	11		
——— of the tragus	0	3	0	3		
Breadth of ears	0	8	0	8		
——— of the tragus	0	2	0	2		
Length of the fore-arm	1	7½	1	6½	1	7
——— of the longest finger	3	0	2	8	2	9
——— of the fourth finger	2	4	2	1	2	0
——— of the thumb	0	4¼	0	4	0	4½
——— of the tibia	0	10	0	8½	0	8½
——— of the foot and claws	0	4	0	4	0	4½
——— of the os calcis..............	0	6	0	6	0	6½
Expanse of wings....................	11	6	10	9	11	4

4. Nyctophilus unicolor, n. s.

All the specimens of this genus I have yet seen from Van Diemen's Land differ remarkably from those of the mainland of Au-

stralia in having the fur everywhere short and cottony, perfectly devoid of lustre, and unicoloured.

That of the upper parts is of a dark olive-brown, without any variation of tint, excepting that it is perhaps a little darker along the middle of the back than elsewhere.

Beneath, the fur is similar, but paler in colour, with the tips of the hairs a little tinged with ash-colour. This is the colour of the whole of the under parts, with the exception of a patch on the throat, which is whitish-brown, dirty white, and occasionally pure white.

Immature examples often have the fur above and beneath of a very dark olive-brown, almost black. One specimen of this dark colour which I have examined, has the spot on the throat almost pure white.

So far as I have been able to ascertain, this species is subject to very trifling variations either in colour or size in the adult state, and the size agrees so closely with that of the species which I have called *N. Gouldi*, that I at first thought the great difference in the texture and colour of the fur was due to the difference of locality.

In the crania, however, I find such differences as are amply sufficient for the distinction of the species *.

The following dimensions are taken from three specimens collected by Mr. Gould in Van Diemen's Land; the first a male, and the second a female, both adult; and the third obviously immature.

	1.		2.		3.	
	in.	lin.	in.	lin.	in.	lin.
Length of the head and body (about)	2	0	2	2	1	10
——— of the tail	1	10	1	8	1	7
——— of the head	0	8½	0	9	0	8½
——— of the ears	0	10	0	10	0	9½
——— of the tragus	0	2	0	1¾	0	2
Breadth of the ears	0	7½	0	8	0	7½
——— of the tragus	0	2	0	1¾	0	1½
Length of the fore-arm	1	7½	1	7	1	6½
——— of the longest finger	2	10	2	8	2	1
——— of the fourth finger	2	2	2	8	2	0½
——— of the thumb	0	4	0	4¼	0	4
——— of the tibia	0	8½	0	7½	0	7
——— of the foot and claws	0	4½	0	4	0	3¾
——— of the os calcis	0	7	0	6½	0	7
Expanse of wings	11	6	11	0	10	4

The crania of the four species here described differ so considerably, that I deem it advisable to make mention of them apart from the foregoing description. By adopting this plan, I am enabled to bring them into more immediate comparison, which is

* To the description of this species should have been added, that the ears are destitute of sulci, and more membranaceous than in the other species, and that the wing-membranes are darker in colour and much more opaque and leathery.

highly desirable when we bear in mind the small size of the objects, and the consequent difficulty of rendering apparent their differences without the aid of figures. They will be described in the following order, the crania of the two species most removed from each other being found to be most dissimilar.

N. Timoriensis.—General form of the skull rather broad and flat, and rather thick in substance; sagittal and occipital crests moderately developed; depression of the nasal bones of nearly equal depth from side to side, broad, with the sides parallel for three-fourths of its length in a backward direction, and then narrowing rapidly to a point at the commencement of the sagittal ridge. Facial portion short; zygomatic arches considerably expanded. Palate nearly as wide anteriorly as posteriorly. Lower jaw strong, its lower margin considerably curved. All the teeth of moderate size and proportions.

N. Gouldi.—General form of the skull much less broad than in the last species, more elevated in the crown, and narrower anteriorly; sagittal crest considerably developed, the occipital one very small; facial depression almost obsolete, narrow, rounded-off on each side, and only amounting to a concavity just at the posterior termination of the nasal bones. Facial portion relatively more produced than in the last species; zygomatic arches but little expanded. Palate much narrower in front than behind. Lower jaw as in the last species. All the front teeth, especially the upper canines, *very short and stout.*

N. unicolor.—General form of the skull very short, as broad relatively as in the first species, but not so flat, and much lighter and thinner in substance than in either of the preceding; sagittal ridge merely rudimentary, occipital one considerably elevated, especially its central portion; facial depression broad, of medium depth, well-defined, and narrower before and behind than in the middle, and with the outline of the nasal bones rather distinctly marked. Facial portion of medium length; orbits much produced in a forward direction, leaving but a small space between them and the roots of the canines; zygomatic arches a good deal expanded. Palate short, nearly as broad in front as behind. Lower jaw short and light, with a moderate degree of curvature. All the front teeth short and small.

N. Geoffroyi.—General form of the skull differing from that of all the others. It is rather long, narrow, and depressed, with a total absence of ridges or crests, and the occipital region rounds-off posteriorly without any angularity. It is thin and somewhat diaphanous; facial depression narrow, deep in the centre, not clearly defined anteriorly, and passing further back than in the other species, its posterior portion being indicated by two thread-like lines which converge to an acute point on the fore part of the central region. Facial portion of medium length, and narrowed anteriorly; zygomatic arches but very little expanded. Palate much narrower in front than behind. Lower jaw slender, with the lower outline nearly straight. Front teeth proportionally long and rather strong.

The crania of these species present the following dimensions:—

	N. Timoriensis.		*N. Gouldi.*		*N. unicolor.*		*N. Geoffroyi.*	
	in.	lines.	in.	lines.	in.	lines.	in.	lines.
Length from the condyloid fossa to the anterior margin of the maxillary bone	0	6	0	5½	0	4½	0	4½
Length from the hinder margin of the parietal bones to the anterior margin of the maxillary bone	0	7	0	6¾	0	6	0	5¾
Breadth across zygomatic arches	0	6	0	5	0	5	0	4½
Greatest breadth of the cerebral region	0	4	0	3¾	0	4	0	3⅔
Greatest breadth of the facial depression	0	2½	0	2	0	2	0	1¾
Length of the bony palate	....		0	4	0	3	0	2½
Length of the series of teeth of the upper jaw, exclusive of the incisors	0	3½	0	3	0	2¾	0	2½
Space between the points of the upper canines	0	2½	0	2	0	2	0	1¾
Space between the posterior molars	0	2¾	0	2¼	0	2¼	0	2
Greatest length of the lower jaw	0	6½	0	5¾	0	5	0	5
Breadth of the lower jaw, taken in a vertical direction from the coronoid process	0	2½	0	2⅓	0	2	0	1¾
Length of the series of teeth in the lower jaw, exclusive of the incisors	0	3⅔	0	3½	0	3	0	3
Space between the points of the lower canines	0	1¾	0	1½	0	1¼	0	1¼

I am especially indebted to Mr. Gould for having placed at my disposal materials which have been of great service in making out the species treated of in the present memoir. The use of specimens collected by him, with the knowledge of their exact localities, has been a great assistance in more respects than one. Besides affording evidences leading to the determination of several species, in a genus formerly supposed to be represented by only one, it has also afforded materials which have tended in some measure to the decision of what constitutes a species and what is only a variety.

It is a well-known fact, that many mammals and birds inhabiting India are found to vary remarkably in size and colour in different parts. Thus if we take some of the Bats as an instance suitable for the present occasion (and we might equally adduce many other mammals and birds) *, we shall find those inhabiting South India and Ceylon smaller and darker in colour than those occurring more northward; and on further examining the matter, we shall further discover that they are referable to the same species, and that intermediate examples may be found at intermediate localities. Not only in external conformation are they similar in their proportions, but also in the details of their osseous system. The skulls of these va-

* Among the Bats may be particularly noticed *Cynopteris marginatus*, *Scotophilus Coromandelicus*, and *Vespertilio papillosus*. See Dr. Kelaart's 'Fauna Zeylanica,' and the appended notes by Mr. Blyth, as also various notices of Mammalia by the latter gentleman in the Journal of the Asiatic Society.

rieties, in which we should expect to find the most constant, and therefore most valuable differences, should any exist, present no variety amongst themselves, excepting that of size ; and in this latter respect they bear an exact relation to the varieties to which they belong.

With a series of specimens before me illustrating this, I have extended the same geographical and anatomical tests to the so-called varieties of the present genus. The results of this attempt were by no means similar to those observed of the Indian species ; for instead of meeting with anything like the gradation which occurs there, I have found that the largest and the smallest examples were alike inhabitants of Western Australia ; whilst a third, which in point of size would have served to unite the two, was separated from them by a wide interval, occurring on the coast of New South Wales. This led to a re-examination of the specimens, and more especially to a comparison of their crania. They were found to be very dissimilar.

Here, then, are two instances, one in which the variation is clearly traceable to an external cause, and accompanied by a uniformity of internal structure, thereby corroborating the unity of the species ; and another, in which the variation is not due to any apparent cause, and not only unsupported by anatomical similarity, but the unity of the species is absolutely disproved by the existence of very diverse osteological characters.

Without dwelling longer on this subject, I may observe, that these remarks have arisen, in the first place, from the consideration of some exceedingly judicious observations on the variation of species, delivered at the Meeting of the British Association at Cheltenham in 1856, by the Rev. Leonard Jenyns. I must refer the reader to the communication printed entire in the Report of the Proceedings of the Association for that year, and content myself with observing that that gentleman urged the necessity of duly considering the influence of climatal and other causes in producing varieties of species ; and also pointed out, that, in the absence of any such causes, any considerable amount of difference from a known species might be regarded as strong distinctive evidence.

Since the preceding account was written, I have obtained another specimen of *Nyctophilus Timoriensis*, collected in some part of Australia, but I do not know the exact locality.

As it is preserved in spirit, and in good condition, I am enabled to give a better account of the form of the face and nose-leaves than that already given, and thus add at the same time to the specific and generic characters.

The first nose-leaf is slightly emarginate and rises from immediately above the nostrils, in such a manner as to give the end of the nose somewhat the appearance of a disc, in which the nostrils are pierced. Between them and the nose-leaf, however, is a deepish transverse depression, with two pits, one over each nostril, which in some measure destroys the regular disc-like appearance of the end of the snout. The nostrils themselves are pear-shaped, with the

narrow ends curving outwards and upwards until they come in immediate contact with the base of the nose-leaf, on each side. Laterally, and below, they are encompassed by the thickened prominent part of the lip, so that they are seen to occupy the bottom of a shallow depression, and open perfectly in front. Between them is a narrow thread-like ridge. Between the first and second nose-leaf is a small but deep hollow or pit, and the second nose-leaf rises behind this in the form of a thick fleshy or cartilaginous projection, not deserving the name of "leaf," transverse in direction, but much narrower and less prominent than the true nose-leaf, and thickly covered with short hairs. Above this appears the facial depression before described. The lower lip is without hairs in front, but the naked part is not clearly defined, as it is in many *Vespertilionidæ*.

The ears are conspicuously sulcated, and their outer margins extend along the side of the face in a line with the cleft of the mouth, and end at a little more than a line from its angle. The tragus presents some points of difference from that of dried specimens. Near the base of the outer edge are two distinct points, and above them some fine crenulations, which are succeeded by a portion of the margin, which is singularly indented. It appears as if this portion were thickened, and a little produced backward and forward; so that when viewing the front surface of the tragus, this part is seen *edgeways*; and when the edge of the tragus is seen, this part presents a *flat* surface *. Above this space the edge again becomes thin, and is finely crenulated to the tip.

The carpus of the closed wing reaches to the front corner of the eye. The wing-membranes extend precisely to the base of the toes, and the *os calcis* occupies about one-third of the space between the foot and tip of the tail. The latter is composed of eight or nine vertebræ, the small terminal one being disengaged from the membrane. All the claws—of wings and feet—are singularly short and weak.

	in.	lin.
Length of the head and body	2	11
——— of the tail	2	0
——— of the head	0	11
——— of the ears..............	0	10
——— of the tragus............	0	3
——— of the fore-arm	1	9
——— of the longest finger......	3	4
——— of the fourth finger	2	6
——— of the thumb............	0	4
——— of the foot and claws	0	5
Expanse of wings	13	0

* If a thin sheet of any material of a pasty consistence were taken, and pressure applied to a small portion of its edge, so as to thicken it, and raise a kind of *rim* or *bur*, visible on each side of the sheet, it would represent pretty exactly this peculiarity of the tragus in *Nyctophilus*. I may add, that having my attention directed to it, I have been able to detect the same peculiarity in the dried specimens, but much less distinctly visible.

MISCELLANEOUS.

PROF. OWEN'S LECTURES ON PALÆONTOLOGY.

These Lectures were resumed, at the Theatre of the Government School of Science, Jermyn Street, on the 15th of April. The subject of the *Enaliosauria* was then commenced, and the following is the conclusion of the Lecture, from the notes of the Professor:—

The general form of the cranium of the common or typical species of *Ichthyosaurus*, e.g. *Ich. communis* or *Ich. intermedius*, resembles that of the ordinary cetaceous Dolphins (*Delphinus tursio* and *Delphinus delphis*); but the *Ich. tenuirostris* rivals the *Delphinus gangeticus* in the length and slenderness of the jaws. The essential difference in the sea-reptile lies in the restricted size of the cerebral cavity, and the vast depth and breadth of the zygomatic arches to which the seeming expanse of the cranium is due; still more in the persistent individuality of the elements of those cranial bones which have been blended into single though compound bones in the sea-mammal. The *Ichthyosaurus* further differs in the great size of the premaxillary and small size of the maxillary bones; in the lateral aspect of the nostrils, in the immense size of the orbits, and in the large and numerous sclerotic plates, which latter structures give to the skull of the Ichthyosaur its most striking features.

The true affinities of the Ichthyosaur are, however, to be elucidated by a deeper and more detailed comparison of the structure of the skull; and few collections now afford richer materials for pursuing and illustrating such comparisons than the palæontological series in the British Museum.

The occiput in the *Ichthyosaurus* is well ossified, and of unusually complex structure. It is formed by the basioccipital, a pair of exoccipitals, a pair of paroccipitals, and by a superoccipital; external to which that surface is extended by the parietals, mastoids, tympanics, squamosals, and pterygoids. The chief peculiarity is the large proportional size of the basioccipital. Its outer surface consists of a large hemispheric condyle, with a plate of bone about half the diameter of the condyle, extending forwards from its under and lateral borders, and subsiding towards the upper border, which is impressed by the rough surfaces for the exoccipitals. Part of the periphery of the condyle is sometimes impressed by a groove indicative of the attachment of the capsular ligament, and in some species there is a vertical depression at the middle of the condyle. The fore part of the basioccipital presents, in some species, a slight median emargination, as if for an outlet of an eustachian canal. Anteriorly the basioccipital joins the basisphenoid, laterally the paroccipitals, superiorly the exoccipitals upon which the superoccipital rests. The latter is a vertical, semicircular, or reniform plate of bone, uniting by its upper borders to the parietals, which, with the mastoids, form the 'occipital crest,' or upper boundary of that region.

The exoccipitals are small and reniform. The paroccipitals are

like ordinary transverse processes, broadest where they join the basi-occipital, and extending outwards to abut by a truncated end against the tympanic pedicle. The centrum, neurapophyses, neural spine, and parapophyses of the last cranial vertebra are unmistakeably demonstrated by the Ichthyosaurian condition of the 'occipital bone' of Anthropotomy. The basisphenoid is an irregular subquadrate plate, narrowest behind, where it joins the basioccipital, expanding as it advances forwards; the anterior margin presenting a rough sutural surface at its middle third for the presphenoid, and a smooth emargination on each side of this forming the hind boundary of the spheno-pterygoid vacuities. The hinder half of the under surface of the basisphenoid presents slight rough tuberosities and depressions for muscular attachment, but no processes; and, like the basi-occipital, it is imperforate. The upper or cranial surface has a median pit. Of the alisphenoids I can at present state nothing more precisely than their very small size. The major part of the proper side-walls of the cranial cavity seems to have been cartilaginous in the *Ichthyosaurus*.

The parietals in some *Ichthyosauri* retain their median suture, from which each bone slopes downwards and outwards, forming, at the anterior three-fourths, a surface at first concave, then convex: the concave part belongs to the upper region of the skull; the convex part passes down to form the inner wall of the temporal fossa: the above part of the parietal is divided by an oblique ridge from the posterior fourth of the bone, which is roughened for the insertion of a strong nuchal muscle, and might be regarded as part of the occipital as well as of the upper region of the cranium. The above ridge is continued on to the upper part of the mastoid, and seems to form the true upper boundary of the occipital region, the posterior borders of the parietal forming a lower second ridge in that region. Of the part of the parietal in advance of the upper ridge, the upper and fore part is concave, the hinder part convex: the concavity is divided by an obtuse angle—scarcely a ridge—from the part which sinks more vertically into the temporal fossa: this angle is continuous with the anterior border of that fossa, so that the crotaphyte muscles may not have had their origin extended upon the upper concave surface. The hinder and outer angle of the parietal is overlapped by the mastoid, and extends to within a third of its lower end, forming part of the sides of the occipital surface, and bounding there, externally, the vacuity between the exoccipital, paroccipital, lower part of mastoid, and the above part of the parietal. The median sutural borders of the parietal diverge anteriorly to form the hind half or third of the 'foramen parietale:' the fore part of each parietal extends further forwards, outside the extremities of the frontals which form the front part of the 'foramen parietale;' and it articulates with the frontal and post-frontal.

The mastoid is a strong triradiate bone, the rays inclining forwards from the centre, which forms the obtuse prominence at each postero-lateral angle of the skull. The upper ray is three-sided, the two upper sides smooth and sloping from the ridge, which is continued

inwards and forwards as a slender process to meet the oblique parietal ridge. The lower ray is a broader plate, smooth and slightly convex outwards, forming the extreme sides of the occipital region; articulating outwardly with the tympanic, and below with the paroccipital and pterygoid. The outer ray is a narrower plate, smooth and slightly convex externally, forming the upper and hinder longitudinal half of the deep zygoma, uniting anteriorly with the post-frontal and externally and inferiorly with the bony plate, described as the "squamous element" of the temporal, in my 'Report on Fossil Reptiles,' 1839, but which I now regard as an accessory sclerodermal bone, analogous to, but not homologous with, the squamous plate in man and mammals.

The presphenoid is a long slender trihedral bone, broadest where it joins the basisphenoid, with the two lower sides converging towards a median obtuse angle. It divides the long and narrow pear-shaped spheno-pterygoid vacuities.

Of the orbitosphenoids I have no accurate cognizance: they may not have been ossified. The frontals are remarkable for their small size, especially in length as compared with breadth, in which one cannot but be reminded of their cetaceous type. The median part of each frontal is convex, the lateral part is concave, notched behind for the parietal, and more deeply in front for the nasal, the process entering which being separated by a very narrow strip of the frontal from the opposite process of the parietal. Laterally the frontals unite by a straight margin directed obliquely outwards and forwards with the post-frontals.

The post-frontal much exceeds the frontal in size; it extends from the upper surface of the cranium horizontally, on each side the frontals, to an equal extent with those bones, then bends obliquely down to form the upper and anterior half of the zygoma. The horizontal plate is semi-elliptic, convex in front, a little concave behind, where it defines anteriorly the temporal fossa. The inner angle overlaps and articulates with the antero-external angle of the parietal; the inner border joins the whole outer border of the frontal, touches the outer point of the nasal; the convex fore-part joins the prefrontal and completes the rim of the orbit above. The zygomatic branch unites with the mastoid behind, and with the super-squamosal and post-orbital below.

The similarity of character in the post-frontal and mastoid is instructive in regard to their general homology.

The prefrontal, I, as yet, know only by its external or facial part. This is a narrow, moderately long, curved bone, extending from the post-frontal to near the nasal aperture, receiving there the upper angle of the lacrymal in a notch, the upper boundary of which is wedged between the lacrymal and nasal: with the latter bone it is in connexion along its whole inner border; it does not join the frontal, and its position and relations in the Ichthyosaurus, as in some fishes, instructively illustrate the true nature of the prefrontal as an element of a cranial segment distinct from that to which the frontal belongs; and not as a mere dismemberment of the frontal

bone. As neurapophyses the prefrontals here lend their whole extent to the support of their neural spine—the nasal bone, which is divided, like the frontal and parietal, by a median suture. The large size of both pre- and post-frontals relates to the large size of the eye, and of the cavity destined to contain it.

The nasals are the longest and largest bones of the cranium; departing, in this respect, widely from the cetacean type, and retaining that of the Labyrinthodont and Crocodilian skulls. They send a pointed process backwards into a corresponding notch of the frontal to close contiguity with the parietals, and they receive in shallower notches the anterior bifurcations of the frontal. The outer angle of the outer notch touches the post-frontal. By the outer border the nasals successively unite with the prefrontal, lacrymal, maxillary and premaxillary, their junction with the former being concealed by the overlapping hind end of the premaxillary; between the lacrymal and maxillary intervenes the nostril, the upper border of which is formed by the nasal.

The palatines are long slender bones commencing behind, between the pterygoid and ectopterygoid, forming the inner boundary of the small palatal nostril; continuing, mesially, in articulation with the pterygoids, until these diminish to a point, then touching each other at the median line, and united externally to the maxillary and premaxillary: the palatal plates of the latter underlap the palatines.

The maxillary commences behind, under the bent styliform jugal, opposite the anterior third of the orbit; as it advances it expands into a palatine and alveolar plate, articulating internally with the ectopterygoid, forming part of the outer boundary of the naso-palatine aperture, and then uniting with the palatine bone and with the palatal plate of the premaxillary. The palato-alveolar part of the maxillary is divided from the facial part by the well-developed external alveolar wall. The facial part, coming into view beneath the fore-part of the malar bone and of the orbit, expands vertically as it unites with the lacrymal to form the lower boundary of the external nostril; in advance of this the maxillary becomes overlapped by the premaxillary, which gradually covers it from view at about the fifteenth tooth, in *Ich. tenuirostris*, counting forwards, but the maxillary extends further forwards, after it is so overlapped. As a general rule, it supports about one-third of the dental series of its own side of the jaw. In Crocodiles the maxillaries support, generally, three-fourths of the dental series, and their relative size to the premaxillaries is greater in Lizards. Fishes present the nearest resemblance to the Ichthyosaurs in regard to the small share which the maxillaries contribute to the formation of the dentigerous margin of the upper jaw.

The premaxillaries, on the other hand, present in the *Ichthyosaurus* as peculiar a degree of superior magnitude; a difference due not so much to the prolonged form of the snout which obtains in *Crocodilia*, as to the disproportionate shortness of the maxillary bones.

Each long premaxillary begins, behind, by an expanded and deeply

bifurcated end; one division being facial, the other palatal. The latter begins by a point at the fore-part of the palato-nasal aperture; it gradually expands as it advances, underlapping the maxillary and palatine bones, and entering into the formation of the alveolar groove at about the fifteenth tooth. The facial plate of the premaxillary begins behind by a bifurcated end, the notch bounding the fore-part of the external nostril; the vertical plate slowly expands, overlapping the nasal and maxillary and gradually descending to the alveolar border, so as to conceal the maxillary at a distance from the nostril equal to the length of that aperture. The premaxillaries form the major part of the upper jaw. The facial plate is impressed by a longitudinal groove near its lower border.

The pterygoid begins behind by a triradiate expansion; the outer short and broad ray or process, abuts against the inner side of the lower end of the tympanic; the upper narrower ray ascends to be wedged between the paroccipital, mastoid, and tympanic; the inner longest ray is broad and flat, obtusely pointed, and wedged between the paroccipital and basisphenoid. In advance of this triradiate expansion the pterygoid contracts, presenting a concave inner border, which articulates with the side of the basisphenoid, and a more concave outer border, which forms the inner boundary of the cavity which was occupied by the cartiliginous petrosal. The bone again expands, its outer border forming an angular process, to the fore-part of which the ectopterygoid unites; the body of the pterygoid then extends as a rather narrow plate of bone obliquely inwards, bounding the pterygo-sphenoid vacuities, and articulating externally to the ectopterygoids, towards the fore-part of which the pterygoid more rapidly contracts, and is continued some way further forwards as a pointed styliform process, internal to the palatine, and coming into contact with the opposite pterygoid near their pointed ends, which form the mid-part of the bony palate.

The ectopterygoids are long plates of bone, with a rounded obtuse hinder end; very gradually expanding to where they join the palatine, then rapidly contracting to a styloid process, forming the hinder and outer boundary of the palato-nasal opening, and uniting there with the maxillary.

The malar is peculiarly long and slender, commencing anteriorly by a pointed end wedged between the maxillary and lacrymal, assuming the form of a round, slender, slightly bent bar, which expands a little to be wedged, at the back of the orbit, between the post-orbital and squamosal. A long vacant space, the lower outlet of the temporal fossa, divides the body of the malar from the ectopterygoid and pterygoid.

The squamosal* is a short and small subquadrate bone, with three of the angles produced, the fourth thickened into an articular or sutural surface. The upper and anterior angle is wedged between the super-squamosal and post-orbital, the lower and anterior angle underlaps the end of the malar; the upper border unites with

* *Os zygomaticum* in 'Report of Brit. Foss. Reptiles,' 1839, p. 92.

the super-squamosal to the end of the upper and hinder angle. The hind border of the squamosal is concave, and forms the fore part of the "meatus auditorius externus:" the hinder half of the under surface of the squamosal expands and is slightly excavated to articulate with the internal swollen condyloid end of the tympanic.

The body of the tympanic is a small subcompressed stem expanded slightly and truncate above, where it articulates with the mastoid and supersquamosal. The outer border of the stem is rounded and concave, forming the inner and hinder border of the "meatus auditorius." The inner border of the tympanic joins the mastoid and pterygoid. The lower end of the tympanic suddenly expands into a large oblique suboval articular surface, convex from before backwards, slightly concave laterally at its fore part.

The articular element of the mandible is adapted to the hinder half of this condyle; the subangular element articulates with the front half.

The lacrymal forms the lower two-thirds of the anterior boundary of the orbit, and sends off from the middle of its outer margin a short plate or process protecting the lacrymal opening: the bone contracts vertically as it approaches the nostril, of which it forms the hind border, which is slightly concave. The upper border of the lacrymal sends posteriorly a process which fits a notch of the prefrontal, and anteriorly it reciprocally receives a process of the prefrontal and also of the nasal. Inferiorly, the lacrymal unites with the maxillary and malar.

The two supplemental bones of the skull, which have no homologues in existing Crocodilians, are the "postorbital*" and "super-squamosal†;" both, however, are developed in *Archegosaurus* and the *Labyrinthodonts*. The post-orbital is the homologue of the inferior division of the post-frontal, in those Lacertians (*e. g. Iguana, Tejus, Ophisaurus, Anguis*) in which that bone is said to be divided. The post-orbital, in *Ichthyosaurus*, resembles most a dismemberment of the malar; its thin obtuse scale-like lower end overlaps and joins by a squamous suture the hind end of the malar; the post-orbital expands as it ascends to the middle of the back of the orbit, then gradually contracts to a point as it curves upwards and forwards, articulating with the super-squamosal and post-frontal.

The super-squamosal may be in like manner regarded as a dismemberment of the squamosal; were it confluent therewith, the resemblance which the bone would present to the zygomatic and squamosal parts of the mammalian temporal would be very close; only the squamosal part would be removed from the inner wall to the outer wall of the temporal fossa. The super-squamosal, in fact,

* Described as "apparently a distinct and peculiar posterior bone" of the orbit, in the 'Report' of 1839.

† The recognized distinctness of this bone in the skull of the *Ichthyosaurus* inclined me, in 1839, to the view of the zygomatic and squamous parts of the "temporal bone" being distinct elements,—an error out of which I worked myself in subsequent toiling at homologies.

occupies the position of the temporal fascia in *Mammalia*, and should be regarded as a supplemental sclerodermal plate, closing the vacuity between the upper and lower elements of the zygomatic arch, peculiar to certain air-breathing *Ovipara*. It is a broad, thin, flat, irregular-shaped plate, smooth and slightly convex externally, and wedged into the interspaces between the postfrontal, postorbital, squamosal, tympanic and mastoid.

The principal vacuities or apertures in the bony walls of the skull of the *Ichthyosaurus* are the following:—In the posterior region, the "foramen magnum," the occipito-parietal vacuities, and the auditory passages; on the upper surface are the parietal foramen and the temporal fossæ; on the lateral surfaces, the orbits and nostrils, the plane of the aperture in both being vertical; on the inferior surface, the palato-nasal, the pterygo-sphenoid, and the pterygo-malar vacuities.

The "foramen magnum" is formed by the basi-, ex- and super-occipitals, the last having as much, or rather more share, than the ex-occipitals; the basi-occipital contributes a very small part below. The occipito-parietal vacuities are larger than in *Crocodilia*, smaller than in *Lacertilia*; they are bounded internally by the basi-, ex- and super-occipitals, externally by the parietal and mastoid. The auditory apertures are bounded by the tympanic and squamosal. The tympanic takes a greater share in the formation of the "meatus auditorius" in many Lizards; in Crocodiles it is restricted to that which it takes in *Ichthyosaurus*.

The orbit is most remarkable in the *Ichthyosaurus* amongst reptiles, both for its large proportional size and its posterior position; in the former character it resembles that in the Lizard, in the latter that in the Crocodile. It is formed by the pre- and post-frontals above, by the lacrymal in front, by the postorbital behind, and by the peculiar long and slender malar bar below. In crocodiles and in most lizards, the frontal enters into the formation of the orbits, and in lizards the maxillary also. In chameleons the frontal is excluded above, and the maxillary below, from the orbit, as in *Ichthyosaurus*.

The nostril is a longish triangular aperture, with the narrow base behind: it is bounded by the lacrymal, nasal, maxillary and premaxillary, it is proportionally larger than in the Plesiosaurus, and is distant from the orbit about half its own long diameter. Like the orbit, the plane of its outlet is vertical.

The pterygo-palatine vacuities are very long and narrow, broadest behind, where they are bounded, as in lizards, by the anterior concavities of the basi-sphenoid, and gradually narrowing to a point, close to the palatine nostrils.

These are smaller than in most lizards, and are circumscribed by the palatine, ectopterygoid, maxillary, and premaxillary. The pterygo-malar fissures are the lower outlets of the temporal fossæ: their sudden posterior breadth, due to the emargination of the pterygoid, relates to the passage of the muscles for attachment to the lower jaw.

The parietal foramen is bounded by both parietals and frontals; its presence is a mark of Labyrinthodont and Lacertian affinities; its formation is like that in *Iguana* and *Rhynchocephalus*.

The temporal fossæ are bounded above by the parietal internally, by the mastoid and postfrontal externally; they are of an oval form, with the great end forward: in their relative size and backward position they are more Crocodilian than Lacertian.

In the *Ichthyosaurus communis* I have counted seventeen sclerotic plates, forming the fore part of the eyeball. In a well-preserved example the pupillary or corneal vacuity, as bounded by these plates, is of a full oval form, $1\frac{1}{2}$ inch in long diameter; the length of the plates (or breadth of the frame) being from 8 to 10 lines. In the same skull the long diameter of the orbit is 4 inches. The deep position of the sclerotic circle in this cavity, showed how they had sunk, by pressure of the external mud as the eyeball became collapsed by escape of the humours in decomposition.

The sclerotic plates are of an irregular, elongate quadrate form: the borders by which they reciprocally join each other by squamous sutures, are the longest, and are irregular; the hind border is about half the length of the plate, and is very thin; the front or corneal border is thicker, shorter, and is straight. From this border each plate extends outwards and backwards as a flat slightly expanding scale for more than half its length; it then suddenly bends backwards and inwards, defining and encasing the extreme periphery or circumference of the eyeball, and indicating the extreme oblateness of the spheroid.

Whenever the antecedent forms of an extinct genus of any class are known, the characters of such genus should be compared with those of its predecessors rather than with its successors or with existing forms, in reference to gaining an insight into its true affinities.

We derive a truer conception of the affinities of the *Ichthyosaurus* by comparison with the Labyrinthodonts and other Triassic reptiles, and of the *Plesiosaurus* by comparison with the Muschelkalk Macrotrachelians, than of either by comparison with modern Lacertians and Crocodilians.

It is commonly said that the *Ichthyo-* and the *Plesio-saurus* resemble more the Lizards in such and such characters, and in a less degree the Crocodiles, as in such a character.

The truer expression would be, that the Lizards, which are the predominating form of Saurians at the present day, have retained more of the osteological type of the Triassic and Oolitic reptiles, and that the Crocodiles deviate further from them, or exhibit a more modified or specialized structure.

As the *Plesiosaurus* is most allied to, or may be figuratively said to be derived from the Triassic *Pistosaurus*, so the *Ichthyosaurus*, by its fluted and partially-folded teeth, their loose implantation, the retention of the postorbital and supersquamosal, and the exclusion of the frontal from the orbits, may be said to be derived from the Labyrinthodonts; but the modifications are now such as to obliterate all trace of the Batrachian affinities.

The occipital condyle is single, as is also the vomer, which forms no part of the bony palate.

The majority of the Saurian characters, in reference to existing reptiles, of the skull are Lacertian, as indicated in the foregoing description.

The complex, extensive and well-ossified structure of the back part of the cranium is similar to that in the Crocodile; but as this is an adaptation rather than a typical conformation, it affords but a slender argument for their affinity, and the plan of structure, with such varieties as do exist, is rather Lacertian. The occipital expanse and strength depend in both the Crocodile and Ichthyosaur on the necessity for a due extent of surface for the implantation of the powerful nuchal muscles which must have mainly wielded a head destined to overcome the resistance of the watery element in the swift subaqueous course of the Ichthyosaur, and of a head produced anteriorly into long and heavy jaws beset with numerous teeth.

The fixation of the tympanic, the posterior position of the orbits, the position and proportions of the temporal fossæ, and the absence of parietal hypapophyses on the basi-occipital, are Crocodilian characters.

The median division of both parietal and frontal, the division of the postfrontal, or superaddition of the postorbital, the meeting of the post- and pre-frontals above the orbit, are characters met with in some existing Lizards, as well in Labyrinthodonts.

The huge orbits, the very long nasal and premaxillaries, the very short and small frontals and maxillaries, the long continuous groove for the loose insertion of the teeth, the shortness but great vertical depth of the compound zygoma, and the non-articulation of the nasals with the maxillaries on the external surface of the skull, are strictly Ichthyosaurian.

The posterior position of the nostrils, the small size and position of the palato-pterygoid foramen, are marks of affinity to *Plesiosaurus,* in common with which genus the cranial structure of the *Ichthyosaurus* exhibits a majority of Lacertian characters.

In comparing the jaws of the *Ichthyosaurus tenuirostris* with those of the Gangetic Gharrial, an equal degree of strength and of alveolar border for teeth results from two very different proportions in which the maxillary and premaxillary bones are combined together to form the upper jaw. The prolongation of the snout has evidently no relation to this difference, and we are accordingly led to look for some other explanation of the disproportionate development of the premaxillaries in the *Ichthyosaurus*: it appears to me to give additional proof of the collective tendency of the affinities of the *Ichthyosaurus* to the Lacertian type of structure. The backward, or antorbital position of the nostrils, like that in Whales, is related to their marine existence. But, in the Lacertians, in which the nostrils extend to the fore part of the head, their anterior boundaries are formed by the premaxillaries: it appears therefore to be in conformity with the Lacertian affinities of the Ichthyosaur that the premaxillaries should still enter in the same relations with the nos-

trils, although this involves an extent of anterior development proportionate to the length of the jaws; and the forward production of these sharp-toothed instruments fitted them, as in the modern Dolphins, for the prehension of agile fishes.

In most Lacertians the median suture of the premaxillaries is soon obliterated; the like obtains in the *Plesiosaurus*, but the suture is persistent in the *Ichthyosaurus*, as in Labyrinthodonts and Crocodiles.

Note on Anemone nemorosa purpurea. By Dr. J. E. Gray, F.R.S. &c.

In general, the flowers of *Anemone nemorosa* are white, or white with a more or less broad purple streak up the centre of the outside of the outer petals. In a field at Pinner, Middlesex, there are patches of this plant, intermixed with patches of the usual kind, which have a darker foliage, and the flower entirely of a dark purple-lilac. I may also add, that the usual colour of the Primrose in the neighbourhood of Haverfordwest is pale bluish-red; and all gradations between that colour and yellow are to be observed.

Description of a new species of Woodpecker. By P. L. Sclater.

Melanerpes rubrigularis.

Supra nitenti-niger: linea circumnuchali ab oculis incipiente, altera utrinque suboculari a rictu latiore, tectricibus alarum superioribus, dorso postico et caudæ tectricibus superioribus, necnon maculis secundariarum trium extimarum apicalibus et in pogonio externo primariarum tertiæ, quartæ et quintæ albis: subtus nitenti-niger, gula media ruberrima, abdomine medio flavicante, lateribus et crisso albo nigroque variegatis; tectricibus alarum inferioribus et remigum pogonio interiore cinerascenti-nigris, maculis quadratis numerosis albis: caudæ rectricibus omnino nigris: rostro et pedibus nigris.

Long. tota 8·5, alæ 5·4, caudæ 3·5, rostri a fronte 1·0, tarsi 0·8.

This Woodpecker, which is represented by Mr. Bridges as very rare, appears to have escaped the researches of the American naturalists; at least I am acquainted with no record of its existence, though it may have been described quite lately. It appears to be well placed in the genus *Melanerpes*, of which no less than six species are already known to inhabit California, namely *M. erythrocephalus*, *M. torquatus*, *M. thyroideus* (Cassin, B. Cal. pl. 32: *Picus nataliæ*, Malherbe, Cab. Journ. f. Orn., 1854, p. 271), *M. formicivorus* (Cassin, B. Cal. pl. 2), *M. albolarvatus*, and *M. ruber*. From all these it is quite different in colouring, and may be recognized at once by its black breast and bright scarlet throat-mark, whence I have named it *M. rubrigularis*.

"A very rare bird, the only one of the species I have ever seen. Shot in Trinity Valley, on the pines. Probably this may occur more

frequently in Oregon or the British possessions. Had it been common, I should have seen it in the southern part of the State of California." T. Bridges—*Proc. Zool. Soc.* Jan. 12, 1858.

Some Observations on the mode of life of a Fossorial Hymenopterous Insect, Cerceris arenarius. By M. H. Lucas.

The mode of life of several species of the genus *Cerceris* has already been made known; but I am not aware that the observations which I was enabled to make last summer upon the *Cerceris arenarius,* Fab., have yet been signalized by authors. On the 16th July of last year, during very hot and stormy weather, I was at Fontenay-aux-Roses, upon a rocky soil, completely exposed to the south. Upon this ground, covered with a thick layer of fine sand, I observed, in a very circumscribed space, twelve or fifteen cylindrical holes, the margins of which were covered with fresh debris, newly moved, and composed of earth, sand, and plaster; above and in the vicinity of these burrows, of which the depth was nearly three centimetres, hovered some Hymenopterous insects, which I recognized as belonging to the genus *Cerceris,* and as being the *C. arenarius,* Fab. Curious to ascertain the proceedings of these industrious insects, I set myself to observe them, and the following are the results to which this study led me.

In the vicinity of these nests, which there is nothing to protect, I observed individuals of *Cerceris* flying about over the habitations, but did not notice any one that ventured to penetrate into them. These individuals, which I ascertained to be males, placed themselves quite close to the aperture of these dwellings, and waited patiently until their inhabitants issued from them. I also noticed that some of these subterranean conduits were occupied by their inhabitants, for from time to time I saw a *Cerceris arenarius* come to the opening, push away the debris, which might have inconvenienced it, with its broad head, protrude a portion of its thorax, survey the neighbourhood, and agitate its antennæ in all directions.

This manœuvre was continued for a considerable time, and during the agitation into which the inhabitants of these retreats threw themselves, the male held himself in observation, and appeared to be watching the issue of these insects. In fact, as soon as they quitted their abodes, they were pursued by the males, and both were lost in the distance. Not understanding the movements of the males, I took some individuals in their nests, and found that the true proprietors of these burrows were females.

Frequently I saw females flying over the holes, and whilst they were in search of their own habitations, the males threw themselves upon them; but the females, not yielding to their solicitations, got rid of them by pushing them away with their hind-feet, and threw them on the sand, where they fell more or less stupefied.

I also observed that the females, on returning to their habitations, held under their sternum, by means of their feet, some bodies of considerable size, which they buried with great precipitation in

their burrows. Wishing to ascertain the prey with which these careful females furnished their larvæ, I captured a considerable number of them, and found that they nourish their progeny with beetles belonging to the family *Curculionidæ* and to the genus *Otiorhynchus.* I also ascertained that the *Cerceris* varied in the selection of species, for I counted four belonging to this generic group, namely *Otiorhynchus scabrosus, sulcatus, raucus,* and *nubilus*; they also furnished me with a *Phytonomus punctatus* and several individuals of *Bromius vitis.* Is it because the species of this latter genus resemble *Otiorhynchi* in their form that this Curculionicidal *Cerceris* furnishes its larvæ with them?

It is only the females that are charged with the care of provisioning the larvæ, and it is only the females that devote themselves to the construction of the burrows destined to protect their progeny. As to the males, I fancy they are vagrants, and that their principal functions consist in the propagation of their species.

All day, and as long as the sun is above the horizon, the females are busy in bringing nourishment to their larvæ, and nothing is more curious than to see how great is their activity, and with what earnestness they perform these operations. Their burrows, which are always cylindrical, are not straight, but usually form a more or less distinct curve: this is easily proved; for if a straw be introduced into these burrows, the aperture of which is about 5 millimetres in diameter, it is very dificult to pass it to the bottom, and then it is felt that the straw changes its originally straight direction in a well-marked curve.

If it be curious to observe the maternal zeal with which these females provision their larvæ, it is no less interesting to witness the activity which they display in the construction, and especially in the repair of their habitations.

Into these holes the provident female carries successively from fifteen to twenty *Otiorhynchi*; and when we observe these beetles, they are found to be in a very decidedly lethargic state. The sting applied to these *Otiorhynchi* by the female *Cerceris* no doubt benumbs the vital principle; and although, at the first glance, they do not seem to have more than a few moments to live, they probably remain alive for several months, that is to say, until the larvæ, for whose nourishment they are destined, have devoured their principal organs. What seems to support the opinion which I here put forward is, that on the 22nd of September I had still some living specimens of *Otiorhynchus scabrosus,* the species most sought for by this Fossorial Hymenopterous insect.—*Comptes Rendus,* 22nd February, 1858, p. 414.

On a new species of Hæmatozoon of the genus Filaria, *observed in the Heart of a Seal* (Phoca vitulina, *Linn.*). By M. Joly.

In dissecting the heart of a Seal (*Phoca vitulina*) the author found several female Nematoid worms, 15 to 20 centimetres in length, and 0·80 to 1 millimetre in diameter. Four of them were fixed in the

right, and two in the left auricle. He considers it to be a new species, to which he gives the name of

Filaria cordis Phocæ.

Adult female. Body whitish, filiform, 15 to 20 centimetres in length, attenuated and recurved like a hook at its posterior portion. *Head* obtuse, without papillæ; *mouth* none; *anus* none. *Integument* finely striated transversely, presenting under the microscope interlaced fibres like those of the skin of *Mermis*, and covering an internal tube formed of longitudinal fibres or lamellæ.
Male unknown.

The female described was stuffed throughout its length with ova and embryos lodged in a tubular ovary, with very delicate diaphanous walls, without any apparent trace of organization. The ova nearest the tail resembled small, irregularly elliptical or spherical masses. Those of the middle of the body contained an embryo rolled upon itself in the manner of those of *Gordius*, described by Grube. In the anterior third of the body there were innumerable free embryos, 0·60–0·70 mill. in length, and 0·001 mill. in diameter, pressed and interlaced together like a tangled knot of microscopic snakes. The development of the ovary was so enormous, that all the other organs of the body had entirely disappeared, and the animal formed an *oviferous* and *embryoniferous* tube, justifying to a certain extent the singular remark of Jacobson, who asks, whether the Guinea-worm (*Filaria Medinensis*) "may not be only a tube or sheath filled with vermicles."

The author then remarks upon the number of *Filariæ* found in all parts of fishes, which constitute the food of the Seal, and also upon the fact that all the true *Filariæ piscium* hitherto observed have been destitute of sexual organs. Hence he concludes, that these *Filariæ* are introduced with the prey into the stomach of the Seal, and after the digestion of the prey, find their way into the blood-vessels, and thus into the heart. From the comparatively large size of the embryos, the author does not consider that they could circulate with the blood through the capillary vessels, like the *Filariæ* of the blood of the Dog; but he adds, that it might be advisable to examine the entire sanguiferous system of dogs with worms in their blood, in order to see whether similar parent *Filariæ* may not also occur in them.—*Comptes Rendus*, February 22, 1858, p. 403.

Osteological Museum in Leyden.

The Dutch Government, with their usual attention to science, have been building a new gallery for their magnificent osteological collection. The entire quadrangle of the older Museum has been heightened another floor and lighted by skylights, which is to be devoted to the osteological collection; the larger specimens, as the Giraffe, Elephant, and Rhinoceros, being placed in erect separate glass cases down the centre of the gallery.—J. E. Gray.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 6. JUNE 1858.

XXXVI.—*Anatomical Observations on a new form of Compound Tunicata.* By John Denis Macdonald, Assistant Surgeon of H.M.S. 'Herald.'

While cruising in Bass's Strait, two beautiful specimens of a compound Tunicary, whose pyriform zooids exhibited much of the characteristic organization of *Boltenia* and *Cystingea*, were taken in the trawl from a depth of 10–12 fathoms. The zooids, each measuring about half an inch in length, were clustered round the upper or free part of a long cylindrical stem, $\frac{3}{8}$ths of an inch in diameter; and, as they were all appended to this common peduncle by distinct pedicles, the whole formed an elegant raceme composed of a transparent, colourless, and delicate cartilaginous basis, the equivalent of the test in simple Tunicata.

It will be convenient to describe this interesting form as preserving what we may assume to be its natural position, viz. with the stem erect, the long axis of the zooids more or less horizontal, and the branchial opening turned upwards; it being understood that the latter and the cloacal aperture hold the same relations that obtain in *Boltenia* and *Cystingea*, the branchial orifice being proximal or nearer the pedicle, and the cloacal, distal or subterminal.

The test is smooth externally, and so transparent that its delicate cells are not very readily detected, though the equable distribution of the bright and rounded nuclei is at once apparent. There are no "pallio-vascular"* processes or ramifications in the proper test of the zooids; but a tubular prolongation of the mantle, running through the pedicle of each, connects it with a

* I employ this term for convenience, not being aware that any distinctive name has been given to the structures to which it is applied in the text.

system of tubes, which exhibit in general a longitudinal arrangement in the tissue of the stem (Pl. XI. fig. 2 *q*), and give rise to numerous sacculations spreading peripherically. When this tubular prolongation is cut across, the test may be easily peeled off, as it were, leaving the animal in a fit state for examination.

The external apertures close up in four irregularly puckered folds, but do not exhibit much prominence.

The branchial orifice, which opens upon the upper surface about one-third from the extremity, is furnished internally with a dense circlet of simple subulate tentacula (fig. 6 *e*), whose bases are continuous, on the one hand, with the epithelial membrane of the branchial sac, and, on the other, with that which invests the muscular coat and the viscera, and terminates in the tubular process of the pedicle above noticed.

The muscular tunic is composed of an open work of delicate fibres disposed in different directions, but chiefly running transversely, and the short cylindrical tubes of the external openings are furnished with circular and radiating bundles strongly resembling those of *Boltenia*.

The mouth (Pl. XI. fig. 2 *f*) is situated near the centre of the inferior wall of the respiratory chamber, leading rather suddenly into a lengthy œsophagus (*g*), which, after having reached the extremity of the thorax, opens into a subglobular stomach (*h*) with thick glandular walls tinted with a reddish-brown pigment. This viscus tapers off internally, to form a kind of duodenum coated with amber-coloured cells, which probably fulfil the office of liver.

The intestine here curves upon itself dextrally, and the rectum may be said to course the whole length of the body and terminate close to the cloacal outlet.

A distinct ovarium (*m*) and testis (*o*) are packed together in the loop of intestine, and the delicate vas deferens and a wide oviduct pass outwards side by side between the œsophagus and rectum towards the cloaca.

Ova in the immature state may be seen in the ovarium, cropping out below the duodenum; but a cluster of several, containing tadpole-like embryos in different stages of development, usually occurs in a sacculus of the duct (*n*) below the œsophagus; while others, still further advanced, appear to lie loosely in the branchial sac, quite unconnected with the cloaca.

The heart (*l*), occupying a distinct pericardium, lies immediately above the intestinal loop; and holding a longitudinal position, its alternately reversed vermicular contractions may be easily observed during life.

A well-marked endostyle (*d*) is traceable along the upper or dorsal wall of the respiratory chamber, from the inner side of

the branchial opening to the cardiac end of the stomach, where it suddenly curves downwards and outwards to terminate near the inner side of the mouth. A line drawn through the branchial and cloacal openings would be nearly parallel to this latter portion of the endostyle, and the transverse bars of the branchial network take the same direction. The more delicate longitudinal nervures, on the other hand, are parallel with the first portion of the endostyle, and rather more closely approximated than is usual in other cases.

The nervous system mainly consists of two small rounded ganglia (fig. 6 *b*) lying one upon another, in a right line with, and about midway between, the branchial and cloacal apertures. The deeper one appears to be the larger of the two, and presents a considerable portion of its surface below the other.

It is rather difficult to trace the course of the nerves which radiate from these centres, both on account of the transparency of the nerves themselves and the manner in which the fibres of the muscular coat intersect them. I have been enabled, however, to follow a delicate tubule from the lateral borders of the larger ganglion to a minute black spot composed of a fine granular pigment, lying at some little distance from the median line on either side; and in this observation I am supported by Mr. F. M. Rayner, who inspected the original preparations himself.

Now, the question arises, what is the nature of these spots? they are not confined to this species, for I have distinctly observed their homologues in the zooids of *Sigillina*. Would it be irrational to surmise that they are rudimentary visual organs? which indeed their *primâ facie* appearance would naturally suggest. Analogy, to a certain extent, forbids this conclusion, and several facts tend to show that they are the remnants of the otolithic sacs (fig. 7 *a* and fig. 8, more highly magnified) which exist in the larva in close contact with the nervous ganglia*. I must, however, defer any further remarks on this subject to a future period.

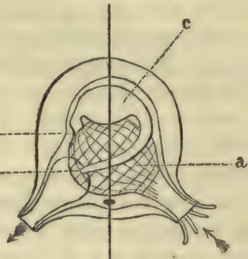
From what has been stated above, it will be seen that the actual relationships of the branchial and cloacal openings, whose position is apparently so anomalous in the present genus, as well as in *Boltenia* and *Cystingea*, do not differ essentially from those which obtain in ordinary Ascidians.

The endostyle, however distorted, must always indicate the dorsal aspect of the animal; hence it would be incorrect to consider the space included between the branchial opening and pedicle, in the genera alluded to, as part of the ventral surface.

* The disposition of the otolithic sacs in relation to the ganglia tends to show that the axis of the future Tunicary is at right angles to that of its embryo.

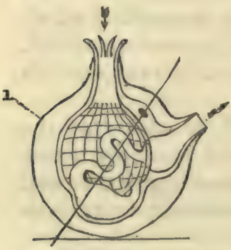
This, however, and other particulars, will be better understood by reference to the annexed diagrams, which are principally intended to show the theoretical changes through which a simple Ascidian plan must pass, to assume successively the characters of a common Ascidian, a *Boltenia,* and a zooid of the genus now under consideration, for which I shall adopt the provisional name of *Chondrostachys.*

A, simple plan of an Ascidian, with the ventral surface turned downwards. The entering arrow shows the branchial orifice with its tentacula, and the emerging one the cloacal outlet: *a,* the branchial sac; *b,* the mouth and œsophagus; *c,* the stomach; *d,* the intestine and vent; *e,* the cloacal chamber. A vertical line is drawn through the nervous ganglion (indicated by a black spot) and the viscera, dividing the body into an anterior and a posterior half; and the deviation of this axis from that of the plan is represented by a corresponding line in the other diagrams, in which also the several parts marked in the plan will be readily recognized.

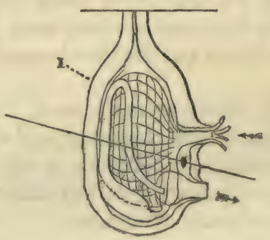


A.

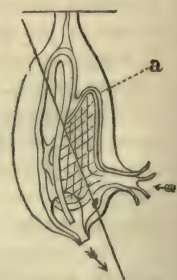
The plan, in the position given, to some extent resembles a zooid of *Pyrosoma*; but if its ventral surface be turned upwards, so that the body may rest principally on the posterior dorsal region, the stomach will then hold a low position; and the intestine, somewhat more lengthened, will naturally take the flexures which it exhibits in the ordinary Ascidian (B).



B



C



D

Let us now suppose this latter form to be suspended from the point 1, B; the body will become elongated, *i.e.* both compressed laterally and depressed in the direction of its vertical axis. The position of the mouth and vent will be lowered, and the loop of

intestine drawn upwards, taking with it the stomach and ovarium. In short, it will have acquired the characters of *Boltenia* (C).

Still further, let the point of suspension be 1, C, and the vertical axis of the body will assume greater obliquity. The endostyle will be bent upon itself (*a*, D), thus altering the direction of the branchial bars; the mouth, stomach, and intestinal loop will be still more elevated, and the anal aperture more depressed, so that the resulting animal will correspond with one of the zooids of our new genus (D).

The points of difference between the latter and *Boltenia* are given in the following columns:—

Chondrostachys.	*Boltenia.*
Tentacula simple.	Tentacula compound.
Mouth nearly opposite the branchial orifice, widely separated from the vent.	Mouth near, and rather inferior to the vent, and both approximating the cloacal opening.
Œsophagus long.	Œsophagus short.
Stomach subglobose, straight, and corresponding with the long axis of the body.	Stomach full, elongated, curved, and nearly parallel with the short axis of the body.
Flexure of intestine dextral.	Intestinal flexure antero-posterior.
Rectum anterior.	Rectum lateral.
Length of alimentary canal from the mouth to the flexure one-half less than from the flexure to the vent.	Length of alimentary canal from the mouth to the flexure rather more than from the flexure to the vent.
No true liver.	A well-organized system of hepatic glands.
No pallio-vascular canals in the test of the body.	Minutely ramified and reticulated pallio-vascular canals in the test of both body and stem.
Only the right ovarium, or that included in the intestinal loop, present.	Both right and left ovaria present.

Whoever looks for a veritable affinity here, will certainly be disappointed, though it must be conceded that the general resemblance is quite as close as one might expect the zooids of a representative compound form could bear to such a remarkable though simple Ascidian as *Boltenia**.

* [We venture to think that the true position of *Chondrostachys* is be-

The genus *Cystingea* with its terminal cloacal opening, so far as the disposition of its alimentary canal is concerned, agrees rather with the characters given in the left-hand column; but in nearly all other particulars, as may be gathered from Mr. W. S. Macleay's beautiful description, its affinity to *Boltenia* can scarcely be questioned.

EXPLANATION OF PLATE XI.

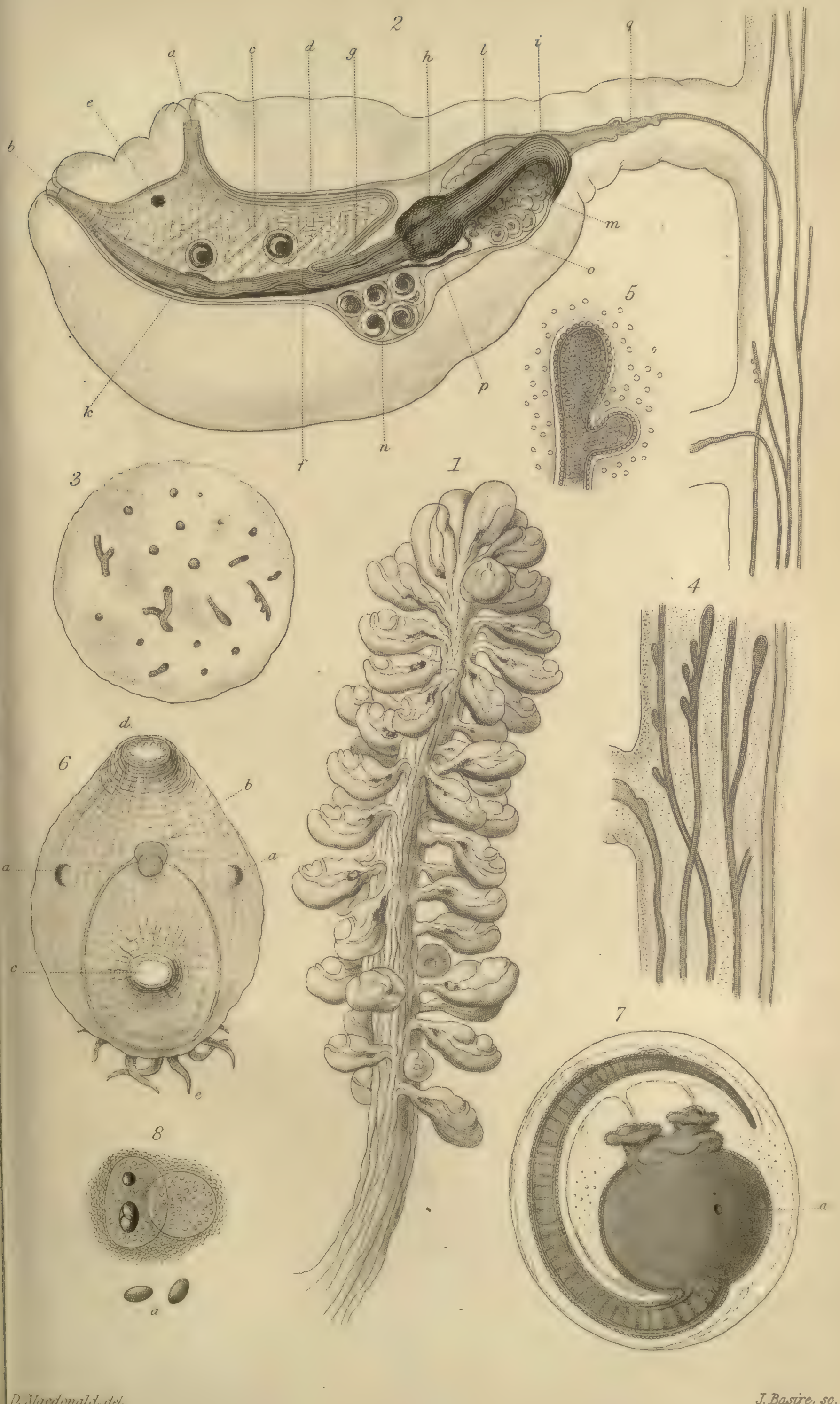
Fig. 1. *Chondrostachys*, natural size.
Fig. 2. One of the zooids, with a portion of the axis magnified: *a*, branchial, and *b*, cloacal orifice; *c*, branchial network; *d*, endostyle; *e*, pseudo eye-speck; *f*, mouth; *g*, œsophagus; *h*, stomach; *i*, intestinal loop; *k*, rectum; *l*, heart; *m*, ovarium; *n*, ova occupying a sacculus of the duct (two others are seen in the branchial chamber); *o*, testis; *p*, vas deferens; *q*, pallio-vascular process leading into the stem.
Fig. 3. Transverse section of stem.
Fig. 4. Longitudinal section of the same, on a larger scale.
Fig. 5. Cæcal end of one of the tubules, more highly magnified.
Fig. 6. Ventral surface of a zooid removed and laid out to show the relation of the pseudo eye-specks *a a* to the ganglion *b*; *c*, branchial, and *d*, cloacal aperture; *e*, some of the oral tentacula protruding inferiorly.
Fig. 7. Tadpole-like embryo within the ovum (one of the three suckers, being situated upon the dorsal aspect, does not present itself in this view): *a*, otolithic sacs.
Fig. 8. Enlarged figure of the otolithic sacs lying upon the ganglion: *a*, otolithes separated from the investing pigment-granules.

XXXVII.—*On the Affinities of the genus* Camptonyx, *Benson.* By Dr. Gray, F.R.S. &c.

There can be little doubt that this genus is a new form of amphibious mollusk, characterized by its cap-like shell, with a groove and keel on the side; but I think, from the account of the position of the eyes, the shape of the tentacles, and the form of the muzzle, as well as the peculiar colour of the shell, that it is much more nearly allied to *Otina* than to *Ancylus*, with which Mr. Benson compares it.

Otina is nearly as terrestrial; it lives among *Lichina* on rocks near the sea, sometimes within reach of the spray, and more rarely in parts covered by the water at very high tides; but it is essentially terrestrial; and as many plants are common to the sea-shore and mountains, the difference between the habitat of *Otina* and *Camptonyx* is not very great.

tween *Clavelina* and *Syntethys*. The relation of the intestine to the branchial sac in *Chondrostachys* removes it from that group of Ascidians to which *Boltenia* belongs.—Ed.]



D. Macdonald, del.

J. Basire, sc.

Otina was formerly confounded with *Velutina,* a marine genus. I showed that it was a lung-breathing animal, and arranged it with *Auriculidæ,* on account of the position of the eyes; but the form of the tentacles induced me, in my last work, to place it as a tribe in the family *Lymneadæ.* The discovery of *Camptonyx,* however, with its similar terrestrial habitat, and having eyes in the same position, indicates the necessity of forming a family *Otinidæ* for the two genera.

The form of the muscular scars in shells depends in great measure on the form of the shell: thus, all very open-mouthed shells, except *Haliotis,* have a large horse-shoe-shaped muscular scar, as that form of adductor muscle is required to keep the shell on the back of the animal; so that the form of the muscular scar and of the shell depend on each other.

May 1, 1858.

XXXVIII.—*Characters of* Tanysiphon, *a new genus of Fluviatile Shells, allied to the* Myacidæ. By W. H. Benson, Esq.

[With a Plate.]

In January 1846, when making one of my latest conchological explorations in the vicinity of Calcutta, I procured on the muddy shore of Tolly's Nullah, near the bridge leading to Allipore, a single valve of a *Potamomya,* and of another bivalve, apparently allied to my ancient acquaintance *Novaculina,* which also inhabits the same water, but differing from it so much in the structure of the hinge, and the greater comparative length of the siphonal scar, that I felt assured of its being the type of a distinct genus, to which I assigned, in MS., the name *Tanysiphonia.* Ten years later, Dr. Theodore Cantor having been appointed to a medical charge on the banks of the small tidal stream in question, I entreated his attention to a search for living specimens, which I felt assured would be found at some depth in the mud at low-water. He kindly answered my call, and after much search by his people, transmitted to me a packet which contained a few specimens of the desiderated shell among a greater number of *Novaculina.* When shown by me to a well-known conchological author, he doubted whether I had sufficient grounds for separating the form from *Novaculina.* Dr. Cantor's attention being then called to the acquisition of the smaller form in a living state, his kind exertions were rewarded by the capture of live specimens in the following spring. These were transmitted, in spirits, with a drawing, and some observations on the external characters of the animal and its affinity, which I find fully borne out by the specimens received.

The examination of the animal not only proved that it was distinct as a genus from *Novaculina*, but that it must be separated from the family of Solenidæ and annexed to that of the Myacidæ. Its nearest relations in that group are probably *Glycimeris* and *Saxicava*, the young of the latter being furnished with cardinal teeth. *Tanysiphon* is found at extreme low-water, by digging to a depth of six inches, or even a foot, in the mud, and occurs in a vertical position. Dr. Cantor states that it is not abundant, and that it was obtainable by his people only in February and March.

I now proceed to describe the shell.

Tanysiphon, Benson, nov. gen.

Testa subinæquivalvis, inæquilateralis, transverse oblonga, umbonibus prominentibus obtusis, extremitatibus (postica maxime) hiantibus, margine superiori subarcuato, ventrali subrecto. Cicatrix siphonalis elongata $\frac{6}{10}$ longitudinis testæ invadens. Valvæ dextræ dentes tres, 1 anterior angustus prominens intrans, 2 laminares transversi, medianus prominens, posterior major obtusus; valvæ sinistræ dentes duo, anterior bilobatus, posterior major. Ligamentum duplex, externum parvum ellipticum, vix convexiusculum, internum lineare foveam posteriorem occupans, demum laminam cardinalem perpendiculariter truncans. Epidermis tenuis. Area interior testæ nitida, non margaritacea.

T. rivalis, Bens., n. s. Pl. XII. B. fig. 3.

Testa tenui, transverse oblonga, antice breviori obtusa, postice longiori, angustiori, extus tenuiter striata et irregulariter remote rugosa, epidermide pallide cornea; natibus decorticatis latis prominentibus, umbonibus obtusis; valvis male congruentibus, per spatium breve cardinale et ventrale solum tactum exhibentibus; humero umbonali antico breviter compressiusculo; area interiori cærulescenti-alba.

Lat. 21, alt. 11, crass. 9 mill.

Habitat in rivo, prope urbem Calcutta Bengalensem.

Some of the teeth are apt, in large specimens, to become obsolete.

The following account is extracted from Dr. Cantor's letter accompanying his interesting drawing of the animal:—

"The siphons closely resemble those organs in *Mya truncata*, Linn., Woodward, p. 317. fig. 220. Both are united in a finely annulated compressed scabbard nearly equalling the length of the shell. A raphe or seam appears along the inferior margin of the scabbard. The free extremity is surrounded by tentacula, which are distant, and of unequal length. The orifices of the siphons are papillular; that of the branchial siphon, the larger, is

provided with minute tentacula, but the orifice of the exhalant siphon is naked. The small foot is hatchet-shaped, with the posterior margin notched. Both the siphons and the foot are wholly retractile, and highly sensitive. The foot is sometimes extended and tongue-shaped, but generally of the outline represented."

The specimens received in spirits show that the mantle is closed at the basal edge, presenting narrow openings at either extremity for the passage of the siphonal sheath and foot. The suture is nearly straight, scarcely undulate. The foot is thick and cartilaginous, broad, and with a pit or depression at the anterior end, and laterally hamate, or bent like the crook of a walking-stick, the point being towards the hinge-side, and the hinder edge straight, not concave.

For comparison with *Novaculina*, I copy the following extracts from my paper published at Calcutta, in the 'Gleanings in Science' for February 1830, a work edited by the late Captain Herbert. It was the precursor of the 'Journal of the Asiatic Society,' and is now very scarce. Reference to that memoir would have probably prevented the form from being confounded as a subgenus under the awkwardly-named *Solecurtus* of Blainville, and from being regarded by several recent authors as merely an estuary shell. The living specimens, from which I drew the characters, were procured in large communities by digging in a strong slaty clay in the banks of the River Jumna, at Humeerpore in Bundelkhund, one thousand miles from the sea by the river line. The dead shells had previously occurred to me in the Ganges, and in the Goomty at Juanpore, between Lucknow and Benares.

The branchial siphon is ciliated in *Solecurtus*; in *Novaculina* both the siphons are destitute of cilia.

Extracts from Description of Novaculina, pp. 63 & 64.

"Animal. Mantle with the basal edges united, forming a tube which encloses the animal, longitudinally constricted at the suture. Foot proceeding from the anterior extremity, short, thick, cylindrical, and very muscular; enlarged at the extremity into a disk with a convex surface, the plane of which is at right angles with the axis of the foot and shell. Siphons separate, as long as the shell when fully extended; the anal one, or that nearest the hinge, half the thickness of the other; apertures constricted, not ciliated."

"As in the Solenaceæ, the edges of the mantle are soldered together at the base, forming a tube which confines the animal and gives more support to its muscular foot, the exertions of

which are principally required in the direction of the axis of the shell......The animal differs from *Solen* in having its siphons free, instead of occupying a common tube; and in having an expanded instead of a conical termination to the foot."

I may also add the following from the characters of the shell: "Epidermis easily detached when dry, folding over the edges and extremities of the shell, and connecting the hinge-margins."

In *Novaculina* there is a strong prominent external ligament, and its internal prolongation is received into a cavity communicating by a lateral posterior opening with the interior of the shell; the salient re-entering teeth—three in the left valve, and two longer in the right—lie under the beaks anteriorly to and quite independent of the ligamental cavity; whereas in *Tanysiphon* two of the teeth in each valve form, as it were, a portion of the wall which separates the ligamental cavity from the interior of the shell, and the anterior tooth in the right valve alone inclines to an independent direction.

For comparison with Dr. Cantor's drawing of the animal of *Tanysiphon*, I add a sketch which I made from a living example of *Novaculina* in Calcutta. It will be observed that the animal failed to protrude the foot, so as to exhibit its form to the extent reached in the Jumna specimens, and that the siphons were also less extended.

Cheltenham, 29th April, 1858.

EXPLANATION OF PLATE XII. B.

Fig. 1. *Tanysiphon rivalis*, natural size (nearly).
Fig. 2. Siphonal tube and siphon, magnified.
Fig. 3. Left valve of *Tanysiphon rivalis*.
Fig. 4. *Novaculina Gangetica*, with animal.

Note.—Dr. Cantor's figure having reference chiefly to the animal of *Tanysiphon*, the part which represents the shell fails to exhibit the general form correctly, especially in the umbonal region. The beaks are too prominent, and are deficient in the breadth which characterizes the genus in this as in the corresponding part of *Novaculina*. Fig. 3 shows the true shape.

XXXIX.—*Observations on* Dracunculus *in the Island of Bombay*. By H. J. Carter, Esq., H.C.S. Bombay*.

Since my "Note on *Dracunculus* in the Island of Bombay" was communicated to the Society in October 1853, and published in the new series of their 'Transactions' (No. 2. p. 45), I have continued to give my attention to the subject when opportunity offered, and have thus been able to correct, to add to, and to

* Communicated by the author; having been read before the Medical and Physical Society of Bombay, Feb. 6, 1858.

clear up many interesting points connected with this Entozoon. They are as follows:—

1. What I have described and figured as the œsophagus (*loc. cit.*) is but the sheath of this organ, inasmuch as the latter may be seen within the former, about 1-600th of an inch in diameter. This corrects the apparent anomaly of the œsophagus being larger, instead of smaller, than the intestine, and makes it agree with the so-called "Tank-worm," whose anatomy, both individually and sexually, with that of other free microscopic *Filariæ* in the island of Bombay, I have lately been able to determine most satisfactorily.

2. What appears to be the intestine, in *Dracunculus*, is the hepatic sheath degenerated, within which again is the intestine, about 1-70th of an inch in diameter. This also corresponds with the same organ in the microscopic *Filariæ*.

3. There is not the slightest difference of form in any part of the ovisac of *Dracunculus* indicating that it was once double, and united together in the centre to form the vagina, as in the free *Filaria*; nor is there any projection, or difference in the size of its calibre, either in the large portion or in its filiform extremities (which are exactly alike), indicative of its having any connexion with a vaginal aperture.

4. The ovisac *bursts* through the body just behind the head of the *Dracunculus*, on the extrusion of the latter from the human body, and does not pass through an aperture ordained for the evacuation of its contents, in this or in any other part of the worm.

5. The third or "small papilla" which I described and figured about the mouth (*loc. cit.*), and through which I wrongly conjectured that the ovisac might have its exit, has a similar one opposite to it; so that there are two prominent and two rudimentary papillæ, if the latter, which are very small, and cannot be seen to project above the surface, be papillæ at all.

6. The œsophagus, intestine, and position of the anal aperture of the young *Dracunculus* correspond exactly with the same organs and the position of the anus in the free microscopic *Filariæ*; but no comparison can be drawn between the generative organs in the two, because they are not developed in the former.

7. Very many species of microscopic *Filariæ* abound in myriads in the salt water of the marshes and main drain, in the freshwater tanks, and in the gelatinous Algæ (*Glœocapsa*) which grow on the sides of old walls and gutters, during the rainy monsoon, in the island of Bombay. Out of several hundred specimens of these, I have met with seventeen distinct

forms: viz. seven in the salt water of the marshes and main drain, of which six are males and females of three species respectively; two in the freshwater tanks, male and female; and eight in the gelatinous Algæ on old walls, among which are six, males and females of three species respectively.

8. Of these it may be stated that the organology in all is the same, and, so far as the alimentary canal goes, exactly like that of the young *Dracunculus*. The generative organs and position of the vulva are, in round terms, the same in all,—that is to say, the vulva is situated towards the middle of the body (from which departs in opposite directions the double tubular ovisac); and the penis consists of two horny spicules approximated at an acute angle just inside the anus, from whence it is exsertile. In all, however, the variety in form of the head or tail, or both, serves not only to distinguish the species, but frequently also the sex of the species. In most (probably all) the œsophagus is furnished with a rigid, sharp-pointed extremity, which is exsertile. Lastly, in all, the young are undistinguishable from each other, and closely allied in form to the young *Dracunculus*; the alteration in the head and tail not taking place before the development of the generative organs.

Observations.—These facts show that the alimentary canal is of the same construction in the young and old *Dracunculus* as in the free microscopic *Filariæ* above mentioned;—that the ovisac of the adult *Dracunculus* is as symmetrical in its two halves as the double ovisac (so-called "uterus") of the microscopic species, but, from want of a vaginal outlet, is a uniform continuous tube, the diminished extremities of which resemble the diminished extremities of the double ovisac, which are, in fact, the ovaries;—that the bursting forth of the ovisac, therefore, in *Dracunculus* is an inevitable consequence, and has its parallel, according to Van Beneden, in the bursting-forth of the "matrix" or so-called "uterus" under corresponding circumstances (that is, when it becomes distended with ova) in the Cestoid Entozoa, *Tænia solium*;—that the œsophagus in *Dracunculus* being of the same construction as that of the microscopic *Filariæ*, is therefore, probably, provided with an exsertile point, which enables it to bore its way through the tissues, after the manner of *Cysticercus*, which is also similarly provided for this purpose; and that this might enable the young of the microscopic species to pass into the human body through the skin direct, or indirectly through the ducts of the sudorific glands, the latter being much larger in calibre (viz. 1-1200th of an inch) than the young *Filariadæ*, which are frequently not wider than a human blood-globule;—that, from what we now know of Parthenogenesis, or

Virgin-generation, the young female microscopic worm might pass into the body already impregnated even before the generative organs can be detected;—that some of the microscopic *Filariæ* above alluded to have two and four minute papillary eminences projecting from their heads, respectively, two of which are larger than the other two, which approximates them still closer to *Dracunculus*;—and lastly, that the microscopic *Filariæ* not only seek a habitat (viz. the gelatinous Algæ and decomposing cells of vegetable matter) where they can obtain nitrogenous food and elements of nutrition like those afforded by the human body, but that it has occurred to me frequently to find a *Nais* (whose habitat also is the *Glœocapsa* during the rainy weather) with its peritoneal cavity containing one or more microscopic *Filariæ,* equal in size to those which are dwelling in the same Alga.

It is true that we have not the means of feeding either man or animals with the young microscopic *Filariæ,* to determine if this would be followed by the production of *Dracunculus,* as the abundance of *Cysticerci* in "measly pork" has enabled Küchenmeister, Van Beneden, Siebold, and others, to prove that the latter, when taken internally, are productive of *Tænia,* or tapeworm; nor would this be likely to succeed if we did possess such means, since it is more than probable that the embryo which produces *Dracunculus,* whatever it may be, enters through the surface of the body. Neither should we be justified in plastering mud over the human body, to satisfy our curiosity in this respect, while the experiment seems to be already performed to our hands, as related in my "Note" under reference, where it is shown that out of a school of fifty boys bathing and dabbling more or less throughout the day in a small pond in their enclosure, whose muddy sediment swarmed with the so-called "Tank-worm," not less than twenty-one in one year had had *Dracunculus* in more or less plurality; while such was not only not the case in any of the other schools of the island, but in the school of which I have had medical charge for more than ten years, with an average number of 346 children present, only two or three cases have occurred during that time; and microscopic *Filariæ* do not exist, so far as I have been able to ascertain, in the sedimentary deposit of the tank in their enclosure, from which the children of this school are solely supplied with bathing-water.

I have only now to add, in support of the inference conveyed by the above remarks respecting the origin of *Dracunculus,* that Prof. Siebold took the larvæ or caterpillars of *Yponomeuta cognatella* and other Lepidopterous insects, and, having placed them in wet mould which abounded with the embryos of *Mermis albicans,*

a worm closely allied to *Gordius*, found, in every instance, that after twenty-four hours the larvæ became more or less infected with these embryos, which had penetrated into their bodies; while the larvæ of *Yponomeuta* being transparent, enabled this sagacious observer to ascertain, by aid of the microscope, that they did not contain any of these embryos before the experiment of bringing the two into contact with each other was performed*. Lespés also, while studying the *Termites*, found whole nests destroyed by the embryos of a Nematoid worm just like our microscopic *Filariæ*, penetrating their bodies and becoming developed in the peritoneal cavity†, as in the instance above mentioned in *Nais*. If, after this, the origin and mode of introduction of *Dracunculus* into the human body be doubted, I can only reply, that I shall be happy to see a better explanation of it. The facts above stated appear to me as conclusive as those of *Cysticercus* producing *Tænia*, or tape-worm; and therefore it remains only to determine which of the microscopic *Filariæ* produces *Dracunculus* in Bombay,—a point which the marked forms of these worms respectively might be expected to render not difficult of demonstration. Indeed, it so happens that the so-called "Tank-worm" (*Urolabes*‡ *palustris*, mihi), which I have taken from the "bathing-pool" of the school mentioned, as well as from other pools, tanks, and collections of dirty fresh water in the island generally, comes nearest to *Dracunculus*. The largest specimens are 1-6th of an inch long, bilabiate, with an exsertile, sharp-pointed œsophagus; the hepatic sheath ending some distance from the termination of the intestine; the vulva opens in the female a little in front of the middle of the body, and the anus posteriorly, just before the body terminates suddenly in a whip-like tail. The penis in the male is exsertile from the anus, *very nearly close* to the posterior extremity of the body, which is so obtuse as to be almost truncated. The tail of the young is semi-geniculated at the base, and there is a gland close to the anus, as in the young *Dracunculus*; that of the adult female varies in length, and becomes curved upon itself when short.

XL.—*Synopsis of the Families, Genera, and Species of the British* Actiniæ. By P. H. Gosse, F.R.S.

In hac Synopsi includuntur tot species Zoophytorum Astræaceorum Britannicorum quot mihi adhuc cognitæ sunt. Desunt

* Ann. des Sc. Nat. sér. 4. Zool. t. iv. p. 56, 1855.

† Annals, vol. xix. p. 388, 1857.

‡ "A holder-on by the tail," which is a character common to all these microscopic *Filariæ*.

nonnullæ, quas, imperite descriptas, vel dubias, non tentatum est generatim distribuere. Tribus CARYOPHYLLACEA ad monographiam futuram postponitur.

ASTRÆACEA.

Fam. I. Sagartiadæ.

Basis adhærens. Tentacula simplicia, in cyclis continuis digesta. Cutis, pro filis retractilibus armatis emittendis, perforata.

Gen. i. ACTINOLOBA (Blainv.). Basis integra, cyclica. Tentacula libenter et totaliter retractilia. Cutis acetabulis egens. Os (ut plurimum) unica canali gonidiali instructum.

1. *A. dianthus* (Ellis). Corpus læve, in impleto columniforme. Os valde sulcatum, sæpissime rufum. Tentacula albo-annulata.

Gen. ii. SAGARTIA (Gosse). Basis integra, cyclica. Tentacula libenter et totaliter retractilia. Cutis acetabulis instructa. Os duabus canalibus gonidialibus instructum.

2. *S. bellis* (Ellis). Discus crateriformis, sæpe undulatus, columna petiolo simulanti. Tentacula plurima, minima, in sex cyclis digesta.
3. *S. miniata* (Gosse). Tentacula, in fronte, duabus lineis subparallelis obscuris signata; in radice, area alba duas vittas nigras ferente: extima medulla coccinea.
4. *S. rosea* (Gosse). Tentacula rosea: intima nonnunquam duabus vittis nigris in imo signata.
5. *S. ornata* (Holdsworth). Tentaculorum radiorumque conjunctio nigricans: vitta alba cordeque albo signata. (*Hanc non vidi.*)
6. *S. ichthystoma* (Gosse). Tentacula minima, marginalia: duabus vittis nigris tenuibus signata.
7. *S. venusta* (Gosse). Discus aureus: tentacula nivea.
8. *S. nivea* (Gosse). Discus niveus: tentacula nivea.
9. *S. sphyrodeta* (Gosse). Tentacula pauca, crassa, nivea; cujusque radix intra annulum purpureum tenuem inclusa, qui in linea marginem versus exit.
10. *S. pallida* (Holdsworth). Tentacula pluria, tenuia, nivea; quodque inter duas lineas cæruleas arcuatas amplexatum.
11. *S. pellucida* (Alder). Prorsus pellucide alba. (*Hanc non vidi.*)

12. *S. coccinea* (Müller). Corpus rufum, albo-lineatum: tentacula pellucida albo-annulata, in imo vitta et duabus triangularibus maculis nigris signata.

13. *S. troglodytes* (Johnston). Tentacula in imo litera nigra B signata.

14. *S. viduata* (Müller). Tentacula tenuia, flexuosissima, linea obscura irrupta utrinque signata.

15. *S. parasitica* (Couch). Tentacula crassiora, linea obscura fracta utrinque signata.

16. *S. Yarrellii* (Cocks). Totaliter hyalina: columna lineis albis signata. Tentacula brevia, obtusa, punctis albis conspersa. (*Hanc non vidi.*)

17. *S. Alderi* (Cocks). Columna hyalina, lineis prasinis signata, quæ pone tentacula producuntur. Discus roseus. (*Hanc non vidi.*)

18. *S. Bellii* (Cocks). Columna, discus, tentaculaque hyalina, maculis flavis signata. Os aureum. (*Hanc non vidi.*)

19. *S.* (?) *chrysosplenum* (Cocks). Columna viridis, maculis flavis linealiter digestis signata. Tentacula annulis viridibus signata. (*Hanc non vidi.*)

Gen. iii. Adamsia (Forbes). Corpus valde depressum. Basis (ætate matura) annularis, ad conchas adhærens. Tentacula brevissima, difficiliter et haud omnino retractilia.

20. *A. palliata* (Boh.). Corpus striis sulcatum: maculis purpureis aspersum.

Gen. iv. Aiptasia (Gosse). Corpus versatile, valde extensile. Tentacula longa, flexuosa, intima longissima, difficiliter et haud omnino retractilia.

21. *A. amacha* (Gosse). Fuliginosa; discus radiis glaucis vel cinereis signatus.

(N.B. Genera Capnea et Corynactis in tribu Caryophyllacea collocantur.)

Fam. II. Actiniadæ.

Basis adhærens. Tentacula simplicia, in cyclis continuis digesta. Cutis lævis, acetabulis verrucis et cinclidibus egens.

Gen. v. Anthea (Johnston). Tentacula flexuosissima, difficiliter raroque retracta. Sphærulæ marginales nullæ.

22. *A. cereus* (Ellis). Tentacula tenuia, corpore longiora, teretia.

23. *A. Tuediæ* (Johnst.). Tentacula crassa, subacuta, corpore breviora, longitudinaliter sulcata. (*Hanc non vidi.*)

Gen. vi. Actinia (Linn.). Tentacula libenter et totaliter retractilia. Sphærulæ capsuliferæ ad disci marginem seriatæ.

24. *A. mesembryanthemum* (Ellis). Columna teres, obesa, mollis.

25. *A. margaritifera* (Templeton). Columna depressa, coriacea, transverse et longitudinaliter sulcata. (*Hanc non vidi.* An distincta a priori ?)

Fam. III. **Bunodidæ.**

Basis adhærens. Tentacula simplicia, in cyclis continuis digesta. Cutis imperforata, verrucis obruta.

Gen. vii. Bunodes (Gosse). Verrucæ teretes, non adhæsivæ, linealiter digestæ. Tentacula maculis definitis signata.

26. *B. clavata* (Thompson). Verrucæ subæquales, punctum rubrum ferentes. Discus tentaculaque punctis albis conspersa. Tentacula tenuiora, apicibus crispis.

27. *B. thallia* (Gosse). Verrucæ subæquales, thalassinæ in fundamine glauco. Tentacula crassa, obtusa, punctis albis sparse signata.

28. *B. gemmacea* (Ellis). Verrucæ magnæ parvæque in seriebus alternis. Columna griseo roseoque varia, sex tæniis albis signata. Tentacula crassa, obtusa, pellucida, in fronte purpurea, maculis ovalibus amplis albis signata.

Gen. viii. Tealia (Gosse). Verrucæ cavatæ, adhæsivæ, indigeste sparsæ. Tentacula brevia, crassa, conica, sine maculis definitis. Cutis cartilaginea.

29. *T. crassicornis* (Müller). Columna rubro viridique varia, verrucis glaucis. Tentacula annulata.

30. *T. digitata* (Müller). Corpus miniatum, verrucis rufis. Tentacula unicolora. (*Hanc non vidi.*)

Fam. IV. **Ilyanthidæ.**

Corporis extremitas inferior obtuse rotundata, sine basi adhærente. Tentacula simplicia, in uno vel pluribus cyclis continuis digesta. Cutis lævis, acetabulis verrucis et cinclidibus egens. Fossores, natatores, aut tubifices.

Gen. ix. Ilyanthus (Forbes). Columna pyriformis, infra in punctum obtusum imperforatum attenuata. Tentacula sex et triginta aut pluria, retractilia. Os simplex.

31. *I. Scoticus* (Forbes). Tentacula tenuia, filiformia, fere in-

star longitudinis columnæ: linea obscura signata. (*Hanc non vidi.*)

32. *I. Mitchellii* (Gosse). Tentacula crassa, conica, instar quartæ partis longitudinis columnæ: vittis transversis signata.

Gen. x. Edwardsia (Quatrefages). Columna vermiformis. Discus tentaculaque in apice cylindri retractilis posita. Pars inferior rara, inflata, translucida, retractilis, imperforata; media plus minusve epidermide opaco incrassata.

33. *E. callimorpha* (Gosse). Tentacula sexdecim, in unica serie digesta, marginalia, subcylindrica, duplo longiora quam cylindrus superior, hyalina, maculis et semi-annulis opacis albis signata.

34. *E. carnea* (Gosse). Tentacula quatuor et viginti, in tribus seriebus digesta, conica, acuta, instar dimidii longitudinis cylindri superioris, annulis carneis alternatis sub-opacis et pellucidis signata.

Gen. xi. Halcampa (Gosse). Columna tenuis, vermiformis. Discus tentaculaque retractilia sine cylindro speciali. Pars inferior rara, inflata, translucida, non retractilis, imperforata. Tentacula duodecim. Os simplex.

35. *H. chrysanthellum* (Peach). Tentacula cylindracea, obtusa, longitudine instar disci diametri; pellucida, vittis angulatis albis signata.

Gen. xii. Peachia (Gosse). Columna crassa, cylindracea vel pyriformis. Discus tentaculaque sine cylindro speciali. Extremitas inferior perforata. Tentacula duodecim, valde contractilia, nec retractilia. Canalis gonidialis unica, ala expansa, protrusili, fimbriata vel lobata instructa.

36. *P. cylindrica* (Reid). Ala gonidialis lobulis duodecim triangularibus miniatis incisa. (*Hanc non vidi.*)

37. *P. hastata* (Gosse). Ala gonidialis lobulis viginti papilliformibus brunneis incisa.

38. *P. undata* (Gosse). Ala gonidialis lobulis quinque quadratis albis incisa.

Gen. xiii. Arachnactis (Blainv.). Columna cylindracea. Extremitas inferior imperforata. Tentacula pauca, in duabus seriebus digesta; exteriora longa, interiora brevia. Natat more Medusæ, per mare expansum.

39. *A. albida* (Forbes). Tentacula exteriora columna longiora, interiora instar quartæ ejusdem. (*Hanc non vidi.*)

Gen. xiv. Cerianthus (Delle Chiaje). Columna cylindracea,

vermiformis, veste membranacea tubulari induta. Extremitas inferior perforata. Tentacula plurima, in duabus seriebus digesta, exteriora longa, interiora brevia.

40. *C. membranaceus* (Gmelin). Semi-pedalis. Tentacula marginalia omnium longissima : annulata.

41. *C.* (?) *vermicularis* (Forbes). Semi-pollicaris. Cyclus tentaculorum mediocrium extra longissima. (Vestis non relata est.) (*Hanc non vidi.*)

Fam. V. **Lucernariadæ.**

Basis adhærens. Corpus crateriforme. Tentacula capitata, in octo fasciculos segregata. Discus octangularis.

Gen. xv. Depastrum (Gosse). Corpus repente contractum, et supra et infra alvum. Tentaculorum fasciculi inter angulos disci positi, vix separati.

42. *D. cyathiforme* (Sars). Semipollicare. Brunneum.

Gen. xvi. Lucernaria (Müller). Corpus expansum supra, gradatim diminutum infra. Tentaculorum fasciculi in apicibus angulorum positi, remoti.

43. *L. campanulata* (Lamx.). Corpus campaniforme, profundum. Petiolus brevis. Colore hepatico.

44. *L. auricula* (Fabr.). Corpus expansum, umbelliforme, minime profundum. Petiolus instar corporis longitudine. Disci anguli æquidistantes. Interanguli (nonnunquam) sphærulis marginalibus instructi. Viridis vel rosea.

45. *L. quadricornis* (Müller). Corpus expansum, fere planum. Petiolus corpore multo longior. Disci anguli in paria conglutinati. Ligni-brunnea.

Has species præcedentes, figuris illuminatis ad naturam depictis, in opere meo, 'Actinologia Britannica,' quod nunc in fasciculis bimestribus publicatur, illustrare propositum est.

XLI.—*Note on the Cell-contents of* Closterium. By Arthur Henfrey, F.R.S. &c.

The remarkable movements occurring in the interior of the cell constituting the individual plant in the genus *Closterium* have attracted the attention of most physiologists, and have given rise to much discussion. Not very long ago, it was re-asserted that the movements were associated with the presence of cilia*;

* Quarterly Journal of Microscopic Science, iii. p. 54, 1855.

but Mr. Wenham* pointed out the error into which Mr. Osborne had fallen, in common with a previous observer, Focke†.

Although assured of the absence of cilia, the movements still appeared to me to present some peculiarities, which were unlike ordinary rotation of the cell-contents; and the reference to this in a recent paper by Prof. Nägeli‡ induced me to re-examine the subject. Nägeli's account of the phænomenon is tolerably correct so far as it goes, but is imperfect; his conclusion, however, in which he propounds that this phænomenon is an example of a peculiar kind of motion, which he calls "*glitschbewegung*" (gliding movement), appears to me unwarranted.

I have very carefully studied, during the present month (May 1858), individuals of *Closterium Lunula* in a healthy state, by the help of a new $\frac{1}{12}$th objective of Ross, using an achromatic condenser. The following has been the result.

The cell-contents exhibit a special mode of arrangement, which will be most conveniently described together with their characters, as observed both in the natural condition and when pressed out carefully from the ruptured cell-membrane. The green matter (endochrome) consists of a tough, slightly elastic, jelly-like substance of a green colour (protoplasm coloured by diffused chlorophyll?); the longitudinal lines are regions where this green jelly is denser, and moreover of a far deeper (grass-) green colour. The large globules distributed in the endochrome are chlorophyll-corpuscles, consisting of a still more dense, green, jelly-like matter bounded by a definite outline, but without a membrane or enclosing pellicle. In the present examples each chlorophyll-corpuscle contained from twelve to twenty angular starch-granules, arranged in the ordinary way of grouped or compound starch-granules, but not absolutely in contact. In their natural state, these starch-granules appeared brighter than the chlorophyll-mass in which they were imbedded; with iodine they were at once coloured violet.

The green mass, consisting of two portions, one belonging to each half of the elongated cell, does not fill the cell, but leaves a clear submarginal space,—the region in which the circulation is observed. The green jelly is not bounded by any pellicle or proper coat; it is somewhat elastic, as above noticed, since by gentle pressure it could be forced up quite to the cell-wall at the margins and ends, and it returned to its place when the pressure was removed (this operation very quickly arrested the circulation). The space between the green matter and the cell-wall is filled by a colourless liquid, in which swim innumerable

* Quarterly Journal of Microscopic Science, iv. p. 157.
† Physiologische Studien, 1st Heft, p. 54, 1847.
‡ Pflanzenphysiologische Untersuch. Zürich, 1855, p. 49.

fine granules, appearing like black specks with the highest powers; besides these point-like granules, the liquid contains a variable but not great number of somewhat larger (perhaps starch-) granules, many of which are often found in the clear spaces at the ends of the cell. The said clear spaces are *vacuoles* in the finely granular protoplasm lying between the green matter and the cell-wall. These vacuoles do not exhibit any rhythmical contraction and expansion, but they alter in form, and even move about in the limited space which they occupy, in obedience to the impulse of the currents of circulation. Normally, or when the circulation is in equilibrium, the clear spaces are round, and in the middle of the bluntly triangular space at the end of the cell. When the currents of circulation are of different force on the two sides, the vacuole is often driven to one or other side; and I have even seen it driven over so as to be partially insinuated into the space at the side of the green matter, as if it were going to travel down in the submarginal space, with the circulating fluids, towards the thicker part of the cell; in all cases, however, it soon returned to its place in the centre of the end-space. By pressure, driving the green endochrome towards the end of the cell, the vacuole was obliterated. The presence of the granules, exhibiting what has been called a "swarming" movement in the vacuoles, is, as we may term it, accidental. They do not always exist there, and are evidently the same larger granules which are found floating about irregularly in the circulating protoplasm. When brought up to the ends, they readily pass into the vacuole; and the vacuole being kept in movement by the eddies of surrounding currents, the contained granules are 'rattled' about as in a box; and their movements being dependent upon external influence, they cannot get out of their prison,—hence their accumulation in the vacuolar spaces. In the submarginal clear region these same granules are seen to be moved, as it appears, irregularly, sometimes forwards, sometimes backwards, sometimes inwards, and often with a tremulous oscillation, like molecular motion. This is attributable to their being taken up and let go by opposing currents of the circulating substance, just as the globules in the central space of the *Chara*-cell are moved onwards by the circulating protoplasm when they come in contact with it.

In the last place, and as the matter of most importance, comes the question of the circulation itself, rendered manifest by the rapid flowing motion of the point-like granules in the colourless submarginal protoplasm. Every one has noticed that the currents flow in various directions, and that the currents often flow towards the end of the cell on *both* edges, so that we have not a true "rotation," as in *Vallisneria*. It may be observed, more-

over, that there are *two currents, going and coming, side by side, on each side.* I have found a current towards the end of the cell running along the inner surface of the cell-wall on both sides, and a counter-current running down in contact with the surface of the green jelly-like endochrome. This gives rise to a double eddy at the ends of the cell, which keeps the vacuoles in motion. The two currents running together at the ends, both turn round and return down the sides of the vacuoles to run towards the centre of the cell in contact with the green endochrome. This double current on each side accounts for the irregular movements of the larger granules which are seen moving about, and, as above mentioned, are often finally deposited in the vacuoles. When in the submarginal space, they naturally fall into the intermediate central tract between the two currents, and are thus urged this way or that way, according as they come more extensively in contact with one or other.

It is curious to contrast the conditions here with those in *Chara.* There, the chlorophyll-layer is outside, next the cell-wall, and the circulating protoplasm within; here, the circulating protoplasm is next the cell-wall, and the motionless chlorophyll-mass occupies the centre. I am not positive whether the green endochrome is solid or hollow; I think solid, but densest at the outer part.

When the cell is ruptured by pressure, the colourless circulating protoplasm absorbs water very rapidly, and, expanding, drives out the green matter with force; if the orifice is small, the chlorophyll-corpuscles and other more solid parts of the green jelly, being resisted to some extent by the borders of the orifice, are jerked out with considerable force. I think this affords an explanation of the mode of escape of zoospores from the cells of Confervæ in general. The appearances are just the same, and a quantity of colourless, finely-granular protoplasm is always found around and among the zoospores in the cell, and is left behind when they escape. When the cell-wall is ruptured, this matter absorbs water greedily, and ejects the semi-solid zoospores, which often do not acquire their cilia and independent power of motion until free.

When the green matter of *Closterium* escapes into the water, it quickly becomes vacuolated and blown out into a froth-like mass, which soon coagulates. The conditions of the contents after their escape into the water afford full proof of the characters of the cell-contents as above described. They consist of fluid and solid substances, of different degrees of density, and presenting striking distinctive characters; the outer circulating fluid being thin and finely granular, and the green endochrome semi-gelatinous, and even still denser in the longitudinal

lines; while it forms semi-solid masses in the chlorophyll-corpuscles. These corpuscles contain imbedded starch-granules in certain stages of development of the cell, being accumulated when the cell is abundantly nourished, and is not in process of division.

The chief points to which I call attention in this note are—1. the existence of diffused or formless chlorophyll constituting the mass of the cell-contents, and containing also chlorophyll-corpuscles of greater density; 2. the description of the course of the circulation as being a current running in one direction over the cell-wall, and in the opposite direction over the green endochrome; and 3. the assertion that the clear spots at the ends are vacuoles.

May 7th, 1858.

XLII.—*On the Development of the Shell and Tube of* Aspergillum. By Dr. J. E. Gray, F.R.S. &c.

Inquiries are so frequently made of me, how the tube of the *Aspergillum* and its fringe can be formed, that I am induced to offer the following explanations of the probable process, in the hope that some naturalist residing on the shores which the mollusk inhabits will verify the theory. As yet, I am not aware that any but fully-developed specimens have been brought to this country. I presume every one knows that the animal lives buried in sand or soft mud, with the broad end and fringe downwards, and the narrow end of the tube just exposed above the surface; and it does not live attached to rocks by the narrow end of the tube, with the broad end, the fringe and cap above, like a flower in the sea, as it is figured in one of the older authors,—a mistake which seems somehow to have taken a firm hold on the public mind, probably because it is anomalous, and against all our previous knowledge of the habit and manner of a bivalve mollusk*.

The mollusk, like all other known Conchifers, in its very young state is free, floating about in the sea, and covered with a pair of regular-shaped, equal valves, united by a ligament. These valves are formed of a thin, opake, white, external coat (which is often eroded at the umbones in the older specimens), and a thicker, pearly, internal layer.

* Miss E. Warne, in a note just received from Alexandria, observes, speaking of the *Aspergillum* of the Red Sea, "You are aware that the disk is the lower end, and the ruffles the upper end; the said ruffles give the different stages of growth. The disk and tube are buried in the sand; it puts forth glutinous tentacula through the tubes. It lives in the little bays of sand formed by the rocky recesses of the coast, where they are in hundreds."

When the free animal has found a situation which is suited for it to take up its fixed abode, it buries itself in the sand, and commences the formation of its tube, which it gradually increases in size downwards as the body of the animal grows in length and diameter, living free in the tube, as the *Gastrochæna* does in its habitation. The valves, during this period of the life of the mollusk, are extended greatly in width (that is, from the dorsal to the ventral edge), to fit themselves to the increased diameter of the body; their front edge is rounded, and the hinder edge is truncated, leaving a large gape for the passage of the siphons, which form a thick cone. The animal and shell remain free in the shelly tube until it has nearly reached its predestined size,—the actual size being more or less influenced by the abundance or scarcity of food in the locality.

When the animal has nearly reached maturity, and feels the approach of the period common to all natural beings, it prepares to complete its development, and shows all its peculiarities. And as *Murices*, *Cassides*, and other Mollusca, at such times produce the edge of their mantle into ridges or processes, which require the production of the parts of the shell which are called *varices*, for their protection, so in this genus, at this time, the valves become united together into a single plate by the deposit of calcareous matter on their inner surface; and this plate is surrounded by and imbedded in the part of the base of the tube that remains to be formed: this causes the animal, which was up to this time free to move about as it pleased in the tube, to become so fixed in it, that it is only able to contract and elongate the hinder part of its body formed of the united siphons.

As the process of development proceeds, the mantle, which was simple, is furnished with a series of cylindrical processes round the circumference of its front end, occupying the base of the tube. These processes are at first simple, but as they are extended in length, become forked, and sometimes re-forked; and as they are produced, a shelly tube is deposited round them, for their protection, which is at first simple, but at length becomes forked, like the cylindrical fleshy processes which they protect; and it is these small tubes, deposited for the protection of these processes, that form the fringe, as it is called, round the base of the large tube, in which the mollusk resides. At length, when the fringe is formed, the entire surface of the front or lower part of the mantle developes similar regularly disposed cylindrical processes, and it is covered with a convex shelly cap, and furnished with small simple tubes or shelly cases, like the tubes of the fringe, for the protection of the processes on the front of the mantle above referred to.

As this part of the mantle has a small subcentral aperture in

it, through which the foot of the animal is emitted in its free state, and as the cap is moulded on the mantle and the processes, there is found in the middle of the cap a narrow slit, with the inner edge raised up, opposite to this pedal opening in the mantle. To show how accurately the cap is cast on the surface of the swollen mantle, there may be observed on its outer surface near the slit, the wrinkles which were to be seen on the skin of the mantle converging towards the pedal aperture.

The umbo of the valves, showing the form of the shell of the very young animal, are to be seen on the outer surface of the lower part of the tube; and the plate, consisting of the united valves, is to be seen on the inner surface of the tube, with the well-marked submarginal muscular scars nearly circumscribing the shape of the very gaping valves.

The upper end of the united siphons often repairs any break that may occur at the smaller end of the tube. In some species, the animal expands the edge of the apical portion of the siphon, and the edge of the shelly tube of the animal is expanded into a shelly frill for its protection. Sometimes these expansions of the end of the siphons take place periodically, and a shelly frill is formed for its protection each time; then the end of the tube is furnished with a succession of crumpled shelly frills or ruffles at a certain distance apart from each other.

Thus the development of the shell and tube of this animal may be divided into four states:—

1. The animal, with its two shelly valves, living free in the sea.

2. The animal takes up its abode in the sand, living free in the shelly tube it has formed.

3. The two valves of the shell become united into a single plate, which is formed into part of the base of the tube still open below.

4. The fringe, and then the perforated cap, closing the base of the tube, are formed.

The *Clavagellæ* and allied genera go through all these stages, like *Aspergillum*, except that the valves never become united, and only one of them is imbedded in and forms part of the tubular house of the mollusk, and it is generally more or less affixed to the cavity in which it is formed.

These genera, in their first stage, are normal Conchifers; in the second, they resemble the usual genera, which, like *Gastrochæna*, live in tubes; it is only in the third and fourth stages that they develope their peculiar generic characters.

These mollusks, like the *Strombs*, *Cypræa*, and several other genera, when they have once developed their full expansion, do not repeat the process, as is the case with the *Murices* and many

other genera, where the animals periodically repeat the expansion, leaving on the shells a succession of the varices and other developments, which mark each successive expansion and degeneration of the animal.

XLIII.—*Descriptions of six newly discovered Species and Characters of a new Genus of* Araneidea. By John Blackwall, F.L.S.

Tribe Octonoculina.

Family Thomisidæ.

Genus Thomisus, Walck.

Thomisus Cambridgii.

Length of the female $\frac{3}{10}$ths of an inch; length of the cephalo-thorax $\frac{1}{8}$; breadth $\frac{1}{10}$; breadth of the abdomen $\frac{3}{20}$; length of an anterior leg $\frac{7}{20}$; length of a leg of the third pair $\frac{1}{4}$.

The eyes are disposed on the anterior part of the cephalo-thorax in two transverse, curved rows, forming a crescent whose convexity is directed forwards; the eyes of each lateral pair, which are seated on a tubercle, are larger than the intermediate ones, those of the anterior row being the largest of the eight. The cephalo-thorax is large, convex, compressed before, rounded on the sides, broadly truncated in front, depressed anteriorly, still more abruptly so towards the base, and has a small indentation in the medial line; the sides are of a brown colour marbled with yellowish-white, and on the posterior part of each there is an oval black patch, with its smaller extremity directed forwards, whose outer margin is broken by a yellowish-white spot; the lateral margins and a large band extending along the middle are of a yellowish-white colour, the latter, immediately behind the eyes, being tinged with brown and marked with spots and two short, parallel streaks of a deeper shade; a short, curved, black line occurs near each side, below the lateral eyes, and the frontal margin is fringed with a row of strong black hairs directed forwards. The falces are short, powerful, cubconical, vertical, and of a yellowish-white colour in front; the base, outer side, and extremity having a brownish-black hue. The maxillæ are somewhat pointed at the extremity, and inclined towards the lip, which is triangular, but rounded at the apex; and the sternum is heart-shaped. These parts are of a pale brownish-yellow colour, the base of the lip, that of the maxillæ on the inner side, and minute spots on the sternum, having a dark brown hue. The legs are provided with hairs and spines, two longitudinal rows of the latter occurring on the inferior surface of the tibiæ

and metatarsi of the first and second pairs; they are of a brownish-yellow colour, the tarsi having a tinge of red, and are marked with streaks, spots, and annuli of a brownish-black hue; the first and second pairs, which are longer and more robust than the third and fourth pairs, are equal in length, and the third pair is the shortest; each tarsus is terminated by two curved, pectinated claws; and the short palpi, which resemble the legs in colour, but are very slightly marked with brownish-black, have a curved, pectinated claw at their extremity. The abdomen is broader at the posterior than at the anterior extremity, sparingly clothed with short hairs, convex above, and projects over the base of the cephalo-thorax; the upper part is of a dull reddish-brown colour, with obscure, slightly oblique lines of a paler hue, and is marked with seven minute, indented, yellowish-white spots describing an elongated angle whose vertex is directed forwards; a short, fusiform line, of the same hue, extends along the middle from the spot forming the vertex of the angle a little beyond the two spots constituting the second pair; the anterior extremity, sides, a space above the spinners, and the under part, are of a pale brownish-yellow colour; on the first there is a curved black band extending to the anterior part of the sides, which are marked with oblique, imperfectly defined, black streaks, and on the posterior extremity spots of the same hue are disposed in longitudinal rows; the under part is minutely spotted with brown, and a brown line on each side of the middle region extends to the spinners, the superior and inferior pairs of which have the second joint of a dark brown hue; the colour of the sexual organs and branchial opercula is reddish-brown, and immediately below each of the latter there is an irregular black spot.

In February 1858, Mr. R. H. Meade forwarded to me this fine species of *Thomisus*, which I have named in compliment to Octavius P. Cambridge, Esq. of Bloxworth House, near Blandford in Dorsetshire, by whom it was captured in that county in the autumn of 1857. Mr. Cambridge, who is a zealous entomologist, having latterly directed his attention to the *Araneidea*, has discovered several species new to science, and others which, though previously known to arachnologists, had not been recorded as indigenous to Britain. My thanks are due to Mr. Cambridge for kindly permitting me to give publicity to these discoveries.

Genus Pasithea, Blackw.

Eyes eight, unequal in size, disposed in three transverse rows on the anterior part of the cephalo-thorax; the two smallest, constituting the anterior row, are near to each other, but not

in contact; each of the two largest, forming the intermediate row, is seated on a tubercle; and the other four constitute the posterior row, which is curved, and has its convexity directed backwards. The entire group describes a sector of a circle whose radii converge towards the frontal margin, thus .

Maxillæ long, dilated at the base, obliquely truncated at the extremity, on the outer side, and inclined towards the lip, beyond which they extend considerably. *Lip* triangular, but notched at the extremity. *Legs* very long and slender; the first pair is the longest, then the second, and the third pair is the shortest.

Pasithea viridis.

Length of the male $\frac{7}{16}$ths of an inch; length of the cephalo-thorax $\frac{3}{16}$; breadth $\frac{3}{20}$; breadth of the abdomen $\frac{1}{10}$; length of an anterior leg $1\frac{1}{4}$; length of a leg of the third pair $\frac{13}{16}$.

The cephalo-thorax is compressed before, rounded on the sides, convex, glossy, with a longitudinal indentation in the medial line; it is of a pale yellow-brown colour, faintly tinged with green, and has a small black spot on each exterior angle in front, immediately above the base of the falces; the entire region of the eyes is densely covered with short hairs of brilliant whiteness, and the space between the posterior and intermediate rows has a dark brown hue. The falces are long, subconical, vertical, and, with the maxillæ and lip, are of a very pale green colour; the lip is much the darkest in the middle, its apex and the extremity of the maxillæ being tinged with pale brown. The sternum is short, broad, heart-shaped, and of a greenish-white colour; it is minutely freckled with dark brown, and has an oblong spot of the same hue at its posterior extremity. The legs are provided with short hairs and long, fine spines; they are of a yellowish-brown colour, the metatarsi and tarsi being much the darkest; the coxæ, femora and tibiæ are marked with small dark brown spots tinged with red, and a fine red line extends along the under side of each femur; the tarsi are terminated by two curved, pectinated claws. The palpi are long and of a pale yellow-brown colour, with the exception of the extremity of the radial joint and the whole of the digital joint, which have a pale reddish-brown hue; the cubital joint has a long spine at its extremity, in front; and the radial joint, which is the longer, has two long spines near the middle, one on the upper and the other on the under side, and projects an obtuse apophysis from its extremity underneath, whose outer side is fringed with long hairs; the digital joint is narrow at the base, and increases in breadth towards the extremity, which abruptly terminates in a

point; it is convex and hairy externally, concave within, except at the compact extremity, and comprises the palpal organs; these organs are moderately developed, complex in structure, with a strong, curved process on the inner side, extending to their extremity, a long and very prominent one directed outwards from the centre, which is enlarged and rounded at its extremity and has a protuberance on its anterior side, and are of a dark reddish-brown colour. The abdomen is long, slender, and somewhat cylindrical, tapering a little to the spinners; it is sparingly clothed with short, light greyish hairs, projects slightly over the base of the cephalo-thorax, and is of a green colour; on each side of the medial line of the upper part there is an obscure whitish band, on which oblique oval spots, of a pale brown hue, inclined towards each other, occur in pairs; and a short, longitudinal, pale brown streak is comprised in the anterior part of the space bounded by the bands; the branchial opercula are tinged with pale brown; a white line extends from each, along the under part, to the spinners, and the space included between them is densely freckled with white.

This handsome spider, which was comprised in a collection of *Araneidea* made in Algeria by John Gray, Esq. of Bolton, and the Rev. Hamlet Clark, in the summer of 1856, and most liberally presented to me by those gentlemen, appears to be most nearly allied to the species belonging to the genus *Philodromus* by its organization; but its habits and œconomy are not known. A striking resemblance to certain species of the genus *Sphasus* may also be observed in the disposition of its eyes.

Genus Sparassus, Walck.

Sparassus currax.

Length of the male $\frac{7}{10}$ths of an inch; length of the cephalo-thorax $\frac{1}{3}$; breadth $\frac{1}{4}$; breadth of the abdomen $\frac{5}{24}$; length of a leg of the second pair $1\frac{7}{10}$; length of a leg of the third pair $1\frac{7}{20}$.

The legs are long, provided with hairs and sessile spines, and have a yellowish-brown hue tinged with red; the second pair is the longest, then the fourth, and the third pair is the shortest; the metatarsi and tarsi are supplied on their inferior surface with numerous dark brown hair-like papillæ constituting a climbing apparatus; and each tarsus is terminated by two curved, pectinated claws. The palpi resemble the legs in colour, with the exception of the extremity of the radial joint, from which a long, slightly curved, pointed apophysis projects on the outer side, and the oblong-oval digital joint, which are of a very dark brown colour, faintly tinged with red; the latter is convex

and hairy externally, concave within, and comprises the palpal organs; these organs are moderately developed, not very complex in structure, consisting of a convex part, membranous at its extremity, which has a yellowish-white tint, and abruptly curved at its base, the curved portion extending along the inner side of the digital joint to the extremity of its concavity; they are of a very dark brown colour. The eyes are disposed on the anterior part of the cephalo-thorax in two transverse rows, each consisting of four eyes; the two intermediate ones of the anterior row, which is the shorter and slightly curved, with its convexity directed forwards, are the largest of the eight, and the posterior row is straight. The cephalo-thorax is large, compressed before, greatly rounded on the sides, convex, hairy, with a narrow, longitudinal indentation in the medial line, and is of a reddish-brown colour. The falces are powerful, conical, vertical, and armed with teeth on the inner surface: the maxillæ are short, straight, convex near the base, and rounded at the extremity; and the lip is semicircular. These parts have a red-brown hue, that of the extremities of the maxillæ and lip being pale yellow-brown. The sternum is heart-shaped, and of a yellow-brown colour. The abdomen is oviform, hairy, and pointed at the spinners, which have a yellow-brown hue; it is of a reddish-brown colour above, a band of a paler hue, bounded by a dark brown line of variable breadth, extending more than half its length; on each side of this band there are two oblong, pale, dull, yellowish spots; and between it and the spinners a few short, curved, transverse lines of the same hue occur; the sides are spotted and streaked with dark brown, and the under part is of a pale, dull yellow colour, with four fine, dark brown lines extending the greater part of its length; the two intermediate ones are near to each other, and their posterior extremities are in contact.

The male of this species of *Sparassus* was included among the spiders collected in Algeria by John Gray, Esq., and the Rev. Hamlet Clark, in the summer of 1856.

Family Drassidæ.

Genus Drassus, Walck.

Drassus micans.

Length of the male $\frac{1}{8}$th of an inch; length of the cephalo-thorax $\frac{1}{16}$; breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{24}$; length of a posterior leg $\frac{1}{6}$; length of a leg of the third pair $\frac{1}{9}$.

The eyes are disposed on the anterior part of the cephalo-thorax in two short, transverse, curved, concentric rows, whose

convexity is directed backwards; the interval between the intermediate eyes of the posterior row is greater than the space which separates them from the lateral ones of the same row, and the intermediate eyes of the anterior row are rather the smallest and darkest of the eight. The cephalo-thorax is oval, slightly compressed before, somewhat rounded in front, convex, glossy, with slight furrows on the sides converging towards a narrow indentation in the medial line; it is thinly clothed with short, hoary hairs, which are most abundant on the anterior part, and has three oblique rows of white hairs on each side, which converge towards its middle: the falces are conical, vertical, with a slight protuberance near the base, in front, towards the inner side, and have two very minute teeth on the inner surface: the maxillæ are powerful, enlarged where the palpi are inserted, gibbous at the base, depressed transversely near the middle, rounded at the extremity, with a small angular projection on the outer side, and inclined towards the lip, which is longer than broad, and rounded at the apex: the sternum is oval, pointed at its posterior extremity, convex and glossy. These parts are of a red-brown colour, the sternum having obscure, dark brown streaks directed from the lateral margins towards its centre. The legs are moderately long, provided with hairs, and are of a brownish-yellow colour, with the exception of the femora of the first and second pairs, which have a brownish-black hue, and the anterior side of the femora of the third and fourth pairs, which has a brown tint; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by two plain, curved claws, below which there is a small scopula. The palpi are slender, and, with the exception of the humeral joint, which is of a brownish-black colour, have a brownish-yellow hue, faintly tinged with red; the cubital and radial joints are short, and the latter, which is the larger, projects a small, pointed apophysis from its extremity, on the outer side; the digital joint is of an oblong-oval form, compact and pointed at the extremity, convex and hairy externally, concave within, comprising the palpal organs, which are well developed, prominent, not very complex in structure, with a process near the middle which is directed forwards, and are of a mingled red-brown and brownish-yellow colour. The abdomen is oviform, glossy, clothed with short hairs, convex above, and projects a little over the base of the cephalo-thorax; it is of a deep black hue, but iridescent, reflecting bright tints of green, purple and copper when viewed in a strong light; the branchial opercula and the medial line of the under part are of a brown colour, and the extremities of the superior and inferior spinners have a somewhat darker shade; there is also a curved transverse line immediately below the

branchial opercula, and a small spot just above the spinners, which are composed of white hairs.

An adult male of this minute *Drassus* was found in Dorsetshire by O. P. Cambridge, Esq., in the autumn of 1857, and was forwarded to me in February 1858 by Mr. R. H. Meade.

Family Theridiidæ.

Genus Pholcus, Walck.

Pholcus ruralis.

Length of the male $\frac{1}{4}$th of an inch; length of the cephalo-thorax $\frac{1}{10}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{12}$; length of an anterior leg $1\frac{7}{10}$; length of a leg of the third pair $\frac{9}{10}$.

The cephalo-thorax is almost circular, somewhat convex, glossy, and has a large indentation in the medial line; the anterior part, on which the eyes are seated, is prominent, and the space between those organs and the falces is broad and nearly vertical; it is of a pale yellow-brown colour, the anterior slope of the indentation being the brownest. The eyes are placed on black spots; the two intermediate ones are much the smallest of the eight, and are situated transversely between three large ones on each side, closely grouped in the form of a triangle. The falces are small, vertical, cubconical, united at the base, armed with a short, slightly curved fang, and have a single strong tooth at their extremity, on the inner side, and a minute, pointed, dark process in front, near the articulation of the fang: the maxillæ are long, and taper to the extremity; they are greatly enlarged at the base, where the palpi are inserted, and inclined towards the lip, which is short, broad, somewhat dilated in the middle, and rounded at the apex. These parts have a brown hue, the lip being much the darkest, and the falces and enlarged base of the maxillæ the palest. The sternum is heart-shaped, and of a brownish-black colour. The legs are very long, slender, and provided with fine hairs, and the femora and tibiæ of the anterior pair have a longitudinal row of short, erect spines on their under side, except at the base of the former and extremity of the latter; they are of a yellow-brown hue; a brown annulus occurs near the whitish extremity of the femora and tibiæ, and the genual joint has a brown hue; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi have a pale yellow-brown colour, with the exception of the termination of the digital joint, which has a reddish-brown tint; the humeral joint is slender at its base, from which an obtuse process projects on the outer side, and is gibbous under-

neath at its greatly enlarged extremity; the radial joint is dilated, convex above, and much larger than the cubital joint; the digital joint is long, enlarged and convex at its base, particularly towards the inner side, and tapers to its extremity, near which there is a prominent, pointed, black process on the outer side; the palpal organs are connected with the inferior surface of the enlarged base of this joint, towards the inner side; they are moderately developed, not very complex in structure, subglobose, with a strong terminal process, which is crescent-shaped at its extremity, and are of a pale yellow-brown colour, that of the extremity of the terminal process being dark reddish-brown. The abdomen is somewhat cylindrical, sparingly clothed with short hairs, and of a dark brown colour faintly tinged with olive-green, the sides of the under part being the palest: it is marked with numerous dull yellow spots; and a short, dark red-brown, fusiform band, having a small angular point on each side, near the middle, occurs in the medial line of the anterior region of the upper part: on each side of the posterior extremity, above the spinners, there is a short, oblique, slightly curved, black line; a broad black band, tinged with reddish-brown at its extremities, extends along the middle of the under part, and the branchial opercula are of a pale dull yellow colour; the part comprised between them is protuberant, and in connexion with the posterior extremity of the protuberance a small, prominent, semicircular, yellowish-white process is situated.

This *Pholcus*, which was comprised in the collection of Algerian spiders received from Messrs. Gray and Clark, resembles the *Pholcus impressus* of M. Koch in several particulars, but is quite distinct from that species.

Pholcus pallidus.

Length of the female $\frac{5}{24}$ths of an inch; length of the cephalo-thorax $\frac{1}{16}$; breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{12}$; length of an anterior leg $1\frac{1}{2}$; length of a leg of the third pair $\frac{17}{24}$.

The legs are very long, slender, provided with fine hairs, without spines, and are of a yellowish-brown colour; a brown annulus occurs near the whitish extremity of the femora and tibiæ, and the genual joint has a brown hue; the first pair is the longest, then the fourth, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The cephalo-thorax is circular, glossy, somewhat convex, and has a large indentation in the medial line; the anterior part, on which the eyes are seated, is prominent, and the space between

those organs and the falces is broad and nearly vertical; it is of a yellowish-white colour, the lateral margins, a streak directed from each intermediate eye to the frontal margin, two irregular confluent spots on each side, and a broad band extending along the middle, having a dark brown hue. The eyes are placed on black spots; the two intermediate ones are much the smallest of the eight, and are situated transversely between, or rather slightly in advance of, the three large ones on each side, which are closely grouped in the form of a triangle. The falces are small, vertical, subconical, united at the base, armed with a short, slightly curved fang, and have a single strong tooth at their extremity, on the inner side: the maxillæ are long, and taper to the extremity; they are greatly enlarged at the base, where the palpi are inserted, and inclined towards the lip: the palpi are short, and provided with long hairs. These organs have a pale yellow-brown hue, the maxillæ being the palest. The lip is short, broad, somewhat dilated in the middle, and rounded at the apex; and the sternum is heart-shaped. These parts are of a dark brown hue, the apex of the lip having a yellowish-brown tint. The abdomen is of an oblong oviform figure, sparingly clothed with short hairs, and of a pale yellowish-white colour; at the anterior extremity of the upper part there are two short, obscure, brownish streaks directed backwards; these are followed by a faint, fusiform, longitudinal band of the same hue, which is bifid at its posterior extremity; it is succeeded by a double series of oval, brownish-black spots disposed in pairs and inclined towards each other; immediately above the spinners there is a pale yellowish-white space bounded by an irregular, brownish-black line, and on the upper part of the sides curved lines of the latter hue occur; the anterior extremity of the under part has a dark brown hue, and three bands of the same colour extend along the middle; the intermediate one is narrower and shorter than the two exterior ones, which are greatly contracted near the spinners, where a pale yellowish-white space occurs, bounded by the extremities of the three medial bands; the sexual organs are prominent, and of a reddish-brown colour.

I am indebted to Mr. Eyton Williams of Denbigh for this remarkable *Pholcus*, which he captured in Pernambuco. It differs from the known species of the genus to which it belongs in having the posterior legs decidedly longer than those of the second pair,—a character constituting an additional bond of alliance to those previously known to connect the spiders of this small group with those of the genus *Artema*.

XLIV. *On the Existence of a Sexual Reproduction in the* Infusoria. By M. Balbiani*.

The discovery of the propagation of the Infusoria by the production of embryos or internal germs, which has already been ascertained to prevail in a certain number of species belonging to different groups, has opened a new field of research in the history of the development of these animalcules. It has shown, in fact, that besides the two truly agamic modes of reproduction, by spontaneous division and gemmiparity, previously admitted in this class, there exists a third mode, capable of a very different interpretation, and which has at least this point in common with the reproduction by embryos of the superior sexual species, that, as in the latter, the young are formed in the interior, if not in a special cavity of the parent which gives them birth. But no one has yet shown that the formation of the embryos in the Infusoria was accompanied by any of the circumstances which indubitably characterize a generation accomplished by the agency of distinct sexual apparatus. Stein was one of the first to call attention to the part played by the nucleus in this production; but he thought that the germs were developed on the surface of this body by a phænomenon of gemmation, which would assimilate them rather to bulbilli or caducous buds, than to embryos originating from fertile ova.

My own observations have led me to regard the origin of these bodies in a different light; I hope that I have been fortunate enough to demonstrate that the phænomena which accompany their formation enter perfectly into the series of those which, in the higher animals, are essentially characteristic of sexual generation. As I cannot, in this note, dwell at any length upon the facts which I have been enabled to observe, and which already relate to six or seven species representing different groups, I shall content myself with giving a rapid sketch of the phænomena relating to the embryonic reproduction of that species in which I have been able to trace it most completely,—the green *Paramecium* (*Paramecium bursaria*, Focke; *Loxodes bursaria*, Ehrenb.).

In this species, as in nearly all Infusoria, there exists a nucleus, which is accompanied here by a small lenticular body, usually lodged in an excavation of the nucleus, near one of its extremities, and generally described under the improper name of nucleolus.

For several generations the *Paramecia* multiply by spontaneous scission, each of the two new individuals obtaining half the primitive nucleus. Such is the very simple phænomenon of

* Translated from the 'Comptes Rendus,' 29th March, 1858, p. 628.

this mode of reproduction; but under the influence of conditions of which we are still ignorant, the species propagates itself in a very different manner, and in the midst of phænomena far more complex than those which preside over the multiplication by fissiparity. In this new mode we shall see the actual anatomical signification of the nucleus and nucleolus, the function of which, if we except the division of the former of these two organs in the act of spontaneous division, has hitherto been perfectly passive. It is, in fact, at their expense that the male and female reproductive elements which characterize this mode of propagation are formed.

When the period arrives at which the *Paramecia* are to propagate with concourse of the sexes, they are seen assembling upon certain parts of the vessel, either towards the bottom, or on the walls. The copulation is always preceded by certain preliminaries which are very curious to observe, but upon which we cannot dwell here. Soon they are found coupled in pairs, adherent laterally and as it were locked together, with the similar extremities turned in the same direction, and the two mouths closely applied to each other. In this state the two conjugated individuals continue moving with agility in the liquid, and turning constantly round their axis. There is nothing, before the copulation, to announce the considerable changes which are about to take place in the nucleus, and the nucleolus which accompanies it. It is during the copulation itself, of which the duration is prolonged for five or six days or more, that their transformation into sexual reproductive apparatus takes place.

The nucleolus has undergone a considerable increase in size, and has become converted into a sort of capsule of an oval form, of which the surface presents longitudinal and parallel lines or streaks. Nearly always, it soon divides in the direction of its greater axis, into two, or more frequently into four parts, which continue increasing independently of each other, and in a very irregular manner, and form so many secondary sacs or capsules. At a period which is still near that of division, these latter appear to be composed of an extremely fine membrane, enveloping a bundle of small, curved bacilla, extending from one extremity of the sac to the other, inflated towards the middle, narrowed towards the extremities. It is these which, when seen through the enveloping membrane, give the capsule the striated appearance which is characteristic of it, and which even exists in the nucleolus at almost all the other periods of the life of the Infusorium. It also contains a perfectly colourless and homogeneous fluid.

At the same time the nucleus has also changed its form and aspect; it has become rounded and widened; its substance has become softer and lost its refractive power, and towards its mar-

gins it presents notches, which, penetrating more and more deeply into its mass, isolate one or more fragments, in which a sufficient magnifying power enables us to see a certain number of small transparent spheres with an obscure central point. In other cases the nucleus, whilst still almost entire, presents this aspect, and then appears as if stuffed with these little rounded bodies, the analogy of which to ovules cannot be doubted in the least. The evolution of the nucleus and nucleolus being identical and progressing at the same rate in the two coupled individuals, it follows, if from this moment we regard the former as an ovary, and the second as a testicle or seminal capsule, not only that each of them possesses the attributes of both sexes, but that they fecundate each other, and serve at the same time as male and female. As regards this fecundation itself, everything seems to prove that it takes place by means of an exchange made by the two coupled individuals of one or more of their seminal capsules, which pass, through the apertures of the mouths closely applied against each other, from the body of one *Paramecium* into that of the other; for, very often, although we may not be able to perceive this passage itself, we may at least detect the moment when one of the capsules already engaged in one of the mouths, is on the point of clearing this aperture. Does the exchange which causes fecundation take place with all the capsules in a single copulation, or in so many successive copulations with different individuals? This is a question the solution of which is not easy, and which, to keep within the field of our observations, we shall not attempt to solve at present.

However this may be, each capsule, after its transmission, still continues to increase in size in the body of the individual which has received it, for we have never found any which had attained the limit of their development in individuals which were still coupled. They then frequently attain a volume greater than that of the nucleus itself, but there is never more than one that arrives at maturity at the same time. When, having arrived at this state, it is examined after being pressed out of the body of the animalcule, to free it from the granulations which mask it more or less while there, it appears under the form of a large ovoid body, the surface of which presents a multitude of parallel striæ directed longitudinally, and due to the arrangement in series of the corpuscles contained in the interior. Compression carried so far as to cause its rupture, shows it distinctly to be formed by a membrane of extreme tenuity, and contents, enclosing an innumerable quantity of small fusiform corpuscles, of which the extremities are completely lost to sight in consequence of their extreme fineness. As soon as they are free, these little bodies show themselves to be animated by a vacillatory and

translatory movement, which soon causes their dispersion in the circumambient fluid. These are the spermatozoids of *P. bursaria.* Iodine, alcohol, and acetic acid instantly stop their movements; they are insoluble in the last-mentioned reagent when concentrated, although this dissolves all the other elements of the body, with the exception of the green granules.

It is usually from the fifth to the sixth day following the copulation, that the first germs are seen to make their appearance in the form of small rounded bodies, formed of a membrane which is rendered very evident by acetic acid, and greyish, pale, homogeneous, or almost imperceptibly granular contents, in which neither nucleus nor contractile vesicle is yet to be distinguished. These organs do not appear until afterwards. The observations of Stein and F. Cohn have shown how these embryos quit the body of the mother in the form of *Acinetæ* furnished with knobbed tentacles,—true suckers by means of which they remain for some time still adherent to the mother, deriving their nourishment from her substance; but their investigations did not reveal to them the ultimate fate of these young animalcules. I have been able to follow them for a considerable time after they detached themselves from the body of the mother, and have convinced myself that, after losing their suckers, becoming surrounded with vibratile cilia, and obtaining a mouth which first shows itself in the form of a longitudinal furrow, they definitely acquired the form of the mother, becoming penetrated in the same way by the green granulations characteristic of this *Paramecium,* without undergoing any more important metamorphoses.

BIBLIOGRAPHICAL NOTICE.

A Cyclopædia of the Natural Sciences. By William Baird, M.D., F.L.S. London and Glasgow. Griffin, 8vo, 1858.

That the preparation of even a popular dictionary of the Natural Sciences, including the wide range of Zoology, Botany and Mineralogy, is a task from which any one man might be well excused for recoiling, will be readily admitted on all hands;—such a work is a gigantic undertaking, in which complete success can hardly be looked for. In the present case, the difficulty is not lessened by the fact that the information to be communicated on this extensive series of subjects had to be selected and compressed, so as to occupy only a single volume; and although this is a stout octavo of more than six hundred pages, those who are at all familiar with natural history will scarcely need to be told that the work of selection and compression must have been an arduous piece of business.

Making due allowance for the acknowledged difficulties besetting

his undertaking, it must be admitted that, with some exceptions, to which we shall hereafter advert, Dr. Baird has succeeded in producing a tolerably satisfactory work, at least so far as the zoological and botanical articles are concerned;—most of the mineralogical notices are of little value, and many of them contain no information whatever.

Even the zoological articles, however, are hardly so good as we should have expected from a writer of Dr. Baird's acknowledged powers; we should have been glad to see the characters of the great groups of animals rather more definitely stated, and we have here and there detected errors of greater or less importance in matters of fact, which ought to have been familiar to the author's mind. Of these we need only cite two or three instances. At p. 17 we are told that the true Crocodiles "are all found in the Old World,"—a statement which is contradicted by the author himself at pp. 177 and 178; at p. 279 the *Hectocotylus* is said to be the male of the Cephalopods to which it belongs; in common with most other writers, Dr. Baird erroneously describes the viviparous *Aphides* as wingless; and at p. 262 he states that it is the female Stickleback that watches its nest. In the same place, his words would indicate that the *Gasterosteus Spinachia* alone of all the Sticklebacks is a nest-building species; although in the preceding page he gives a large woodcut of the common *G. aculeatus* with its nest. The articles on the different classes of monsters also appear to us to be quite out of place in a work of this description.

But we must pass from these minor matters to the consideration of a more serious and, to us, quite unexpected defect in the zoological portion of this Cyclopædia of the Natural Sciences,—a confusion which will effectually prevent even the most laborious student from acquiring any clear idea of zoological classification from its pages, and which is evidently due to the author's having set about his task with no definite system preconceived in his own mind. This is betrayed even by the table of the classification of animals prefixed to his work, according to which the animal kingdom consists only of *three* subkingdoms,—the Vertebrata, Mollusca, and Articulata,—the latter including everything from Insects to Sponges, and forming fourteen classes *numbered consecutively*. At the first glance, we were doubtful whether Dr. Baird might not have some hidden meaning in adopting this course,—whether it might not be intended to indicate, that, the position of the Echinodermata on one side or the other of the line of demarcation between the Annulosa and Radiata being still a disputed point, this line itself might be equally considered as mythical, and therefore disregarded. Such an idea naturally sent us in all haste to consult the body of the work, to see what reasons might be adduced there in support of such revolutionary views; but our curiosity was doomed to be disappointed,—the old subkingdoms of Articulata and Radiata stood in their proper alphabetical rank; and, to make the matter worse, the line of demarcation was rendered more mythical still by the Entozoa being cited as forming a class under both. Other confusions of a similar nature occur frequently on comparing the table of classification with the body of the work; numerous groups

are mentioned in the one and not in the other; and it is evident that the table was prepared after the completion of the rest of the book, and with little or no reference to it. Even in some of the articles themselves we find evident traces of the same confusion of ideas,—a glaring instance of which is exhibited by the notices on the *Macropidæ* and *Marsupialia*: in the former the whole of the Marsupials are referred to the family *Macropidæ*, and placed, in accordance with Dr. Gray's views, amongst the *Feræ* (in the table); whilst in the latter the *Macropidæ* constitute only one family of the *Marsupialia*.

We trust that should the work come to a second edition, Dr. Baird will endeavour to remove the causes of these objections, and thus furnish the public with what is much wanted,—a reliable work of reference on general Natural History. The publisher has evidently done his part well;—for a cheap work, the volume is well printed; the illustrations are numerous, and many of them new; and a useful map of the geographical distribution of some of the principal forms of animals is attached to it.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

January 26, 1858.—P. L. Sclater, Esq., F.L.S., in the Chair.

Notice of a New Genus of Uropeltidæ from Ceylon, in the Collection of the British Museum. By Dr. J. E. Gray, F.R.S., V.P.Z. and Ent. Soc. etc.

In examining the reptiles recently acquired in the British Museum, Mr. Edward Gerrard observed a Saurian from Ceylon, which he believed to be new. I have great pleasure in sending a description of it to the Society, and in naming it after Mr. Gerrard, the preparer of the osteological specimens and of the animals in spirits in the British Museum, who has a most extraordinary empirical knowledge of the osteology of the different vertebrated animals and of the species of reptiles and fish.

Mitylia, n. g.

Head tapering in front, acute; rostral scale produced, compressed, acute, bluntly keeled above and below. Tail very short, subconical, rounded, covered with very close-set rough scales, each marked with two slight ridges of small asperities, with a central terminal rough oblong plate furnished with a perpendicular blunt keel; subcaudal shields in five rows, central series rather wider, six-sided; vent with two shields in front, and one in front of them between their bases.

Mitylia Gerrardi.

Black; sides with a series of short white perpendicular bands; underside white, with a black spot in the middle of each scale, a

white oblong four-sided spot over the base of the caudal rugosity; subcaudal scales few, with a small black spot in the centre of each.

Hab. Ceylon.

The form of the head agrees with the genus *Rhinophis* of Wagler; but it differs from that genus in the shortness, and especially in the structure, of the caudal shield, which, in that genus, is formed of a single horny conical plate.

Notice of the Bosch Vark (Potamochœrus africanus), living in the Gardens of the Society. By Dr. J. E. Gray, F.R.S., V.P.Z.S., etc.

It was with great pleasure I was able to examine a living specimen of the *Bosch Vark* from the Cape of Good Hope, as some zoologists who had lived at the Cape had expressed to me a doubt as to the distinctness of the Painted Pig of the Camaroons from the *Bosch Vark* of the Cape, which they informed me is apt to vary in colouring, being sometimes fulvous.

Any one who examines the two living animals as they are now placed, in two paddocks side by side, in the Gardens, must at once be satisfied of the distinctness of the species of the two animals, quite independent of any variation that may occur in the ground colour of the individuals, and at the same time be convinced of their distinctness from the other Pigs and of their alliance to each other. Their differences may be thus stated in parallel columns:—

P. africanus, S. Africa.	P. penicillatus, W. Africa.
The hair very long, blackish.	The hair short, adpressed, deep red.
The nuchal crest very large, bushy, and extending over the shoulder.	The nuchal crest small, low, white, forming a narrow line.
Tail slender, placed rather high up.	Tail very thick, placed very high up in the haunches.
The ears moderate, rather broad, with a small pencil at the tip.	The ears large, elongate, narrow, with a large terminal pencil.

These descriptions were taken at the same time of the year.

The two sexes of the two species are similarly coloured and agree in the above characters. There are also several other distinctive characters not so easily described.

February 9, 1858.—Dr. Gray, F.R.S., V.P., in the Chair.

Mr. Gould exhibited to the Meeting British specimens of the *Motacilla flava* of Ray, which had been shot by Mr. Thirtle of Lowestoft, to whom Mr. Gould was indebted for the following note as to its occurrence in that part of England:—

"In February 1855, at Lowestoft there were to be seen on a large extent of waste grass land called the Denes, from 70 to 80 Yellow

Wagtails, which is a very uncommon occurrence, for we seldom have more than two or three pairs during the whole summer, and last summer (viz. 1857) I did not see one, although I looked for them several times.

"The birds named as above in 1855 were to be seen from about the 12th of February until the latter end of March. On the 14th of February I observed amongst them a Grey-headed Wagtail, and immediately went home for my gun, and I shot it and preserved the same: the head was only partially grey. The next day I killed a better specimen; and within a fortnight from killing the first, I obtained seven specimens in all, they being all male birds. I have no doubt that there were females with them, but I could not make them out from the Yellow Wagtails.

"The last killed were in the best plumage.

"During the time these birds were on the Denes the wind was blowing from the north-east, with bright sunny days; and the wind had been blowing from the same quarter from about Sept. 20th, 1854, and continued to do so until April 13th, 1855, not having any other direction for twenty-four hours during the whole time.

"I know only of two instances of the Grey-headed Wagtail being killed in this locality—one male in the last week of May 1851, and a male in May 1852: this was with a female.

"James Thirtle,
"*Bird Preserver, &c., Lowestoft.*"

Mr. Gould also called the attention of the Meeting to three beautiful specimens of Steller's Duck, which had been brought for exhibition by Mr. Stevens. Mr. Gould remarked, that although this species was a native of high northern regions, even to within the Arctic circle, it had been more than once killed in England. The bird certainly belongs to the family of the true diving ducks, of which the King and the Eider may be considered typical examples, and with these it has usually been associated by ornithologists; but the female differs remarkably from the females of those species in possessing a well-marked speculum on the wing, and the bill on examination will be found to differ in form, approaching nearly to that of the Smew (genus *Mergellus*), or perhaps still more nearly to that of *Merganetta*; but it is not precisely like that organ in either of those genera, and Mr. Gould therefore considered that Mr. G. R. Gray had very properly made it the type of a new genus, *Eniconetta.*

On the Characters of four species of Bats inhabiting Europe and Asia, and the description of a New Species of Vespertilio inhabiting Madagascar. By Robert F. Tomes.

One of the most beautiful of the Bat kind is the *Vespertilio pictus* of Pallas. Like many of its congeners, it has been abundantly supplied with titles. One of these is *Vesp. Kerivoula,* given to it by Boddaert.

Dr. Gray having perceived that it possessed some peculiarities

which entitled it to further consideration, and to still further distinction, proposed to elevate it to the rank of a distinct genus, and employed the rejected name given to it by Boddaert by which to designate the new genus.

In the 'Annals and Magazine of Natural History,' vol. x., Dr. Gray made it the type of his genus *Kerivoula*, and associated with it several other species which he considered as representatives also of the new genus. Without going at length into the details of the examination which have led me to make use of the generic name above noticed, I may mention, that throughout the present communication, whenever I have occasion to speak of the species, it will be under the name of *Kerivoula picta*. But whilst I adopt this name for the species, I reject most of the associates provided for it.

The great beauty of the *Kerivoula picta* consists in its bright rust-coloured fur, and in its pied orange-and-black membranes. But there is another species which in respect of colour greatly resembles it, indeed far surpasses it. It is a native of China, and the specimen from which the illustration accompanying the present paper was taken, was presented to the British Museum by Mr. Fortune, its precise locality being Shanghai.

At the time the illustration was executed, I supposed, from the extraordinary richness of its colour, that it could not be a known or described species, and I had proposed to give it the name of *Vesp. rufo-niger*. A careful examination, however, of specimens of *Vesp. formosa* in the British and East India Company's Museums has shown me that it differs from that species chiefly in the intensity of the colour of the fur and membranes.

The examination of these examples led further to the inspection of the *Vesp. rufo-pictus* of Waterhouse, and again to some other species possessed of similar forms, but not gifted with the beauty of colour observed in those mentioned above.

It will be the purpose of this communication to point out these species, and to endeavour to show that none are referable to the genus *Kerivoula* (supposing it to be typified by the *Kerivoula picta*), in which some of them have been placed by Dr. Gray.

In general form the examples of this group—scarcely of subgeneric importance—bear some resemblance to the common *Vesp. murinus* of Europe. They all have a somewhat thick though not broad muzzle, and a crown but slightly raised above the level of the face; nostrils which are removed from each other by only a moderate interval, and that interval not emarginate in the specimens preserved in spirit, although very slightly so in those which are dried. The ears are in all the species more or less ovoid, and deeply and evenly hollowed or scooped out about the middle of the outer margin, as in the *Vesp. emarginatus* of Europe. The tragus is rather long, nearly straight, and diminishes evenly to an acute point. The membranes of the wings extend to the base of the toes, and the latter are much longer than the remaining part of the foot; and as if for the sake of uniformity, the terminal phalange of the thumb is much longer than the basal one*.

* The great length of the toes in relation to the length of the foot depends

The fur is everywhere thick and *cottony*, and is either bicoloured or tricoloured, with a tendency to spread on to the upper surface of the interfemoral membrane.

At present I have not had the opportunity of examining the cranium of either of the species, but am able to observe in the specimens in spirit and in those in skin, that the front teeth are of considerable substance in relation to their length, and that the upper incisors are placed in pairs, the pairs being separated from the canines by a considerable interval on each side, and from each other by a central interspace.

From the *Kerivoula picta*, and a few more allied species, this group differs remarkably in not having the top of the head elevated, in having the muzzle much thicker relatively, in the greatly inferior development of the ear-conch, and in several other minor details. However, it agrees with *Kerivoula* in the form of the tragus, and in some measure in the texture of the fur.

1. Vespertilio emarginatus, Geoff.

V. emarginatus, Geoff. Ann. du Mus. t. viii. p. 198. pl. 46 & 48, 1806; Desm. Mam. p. 140, 1820; Millet, Faun. de Maine et Loire, t. i. p. 10, 1828; Fisch. Synop. Mam. p. 105, 1829; Bonap. Fauna Italica, i. 1832–42; Temm. Mon. ii. p. 190. pl. 51, 1835–41; Hollandre, Faune de la Moselle, p. 6, 1836; De Selys-Longch. Etud. Micromamm. p. 139, 1839; Faune Belge, pp. 1, 20 & 300. pl. 2. f. 4, 1842; Schinz, Europ. Fauna, i. p. 15, 1840; Synop. Mamm. i. p. 154, 1844.

Although the present well-marked species is cancelled from the European list by MM. Keyserling and Blasius, it is certainly a perfectly distinct and easily recognizable species, and not uncommon in several localities on the continent of Europe; but does not I believe occur in the British Islands. I have seen and examined specimens in the Museums of Leyden and Paris; in the latter, the type specimens from Charlemont and Abbeville, together with others collected by M. de Selys-Longchamps in Belgium; but I sought in vain for the specimen which M. Brongniart obtained near Dover. I believe that it was merely an old female of *V. mystacinus*; and perhaps from its cranium the illustration was taken which accompanies the description given by M. Geoffroy. At any rate that figure represents with tolerable accuracy the cranium of *V. mystacinus*, and is obviously too small for the *V. emarginatus*, as well as being too

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very much on the elongation of the phalange next to the one bearing the claw; and it is the corresponding phalange of the thumb that is so much the longest. It would appear worthy of inquiry whether the corresponding phalanges of the fingers are relatively longer. This I do not find to be absolutely the case, although in *Miniopteris* reversed proportions of the comparative length of the toes with the remaining part of the foot take place, accompanied by corresponding reversed proportions in the length of the phalanges of the fingers. Thus the toes are short, and the phalanges of the fingers which answer to them, equally short; in the present group the toes are long, and the joint of the thumb which corresponds, elongated in accordance with them; but the wing-joints exhibit no such relative proportions.

much inflated. I arrived at this conclusion, having before me the plate and the type specimens.

I cannot learn that this species has been met with, excepting on the continent of Europe. Whilst many other European species occur not only over the whole of Europe, but also in Madeira, the Mediterranean shores of Africa, and even as far in Africa as Lake Ngami, the present one appears to be confined to France, Belgium, Holland, and the environs of Rome.

The following description has been taken from the specimens in the Paris Museum:—

Muzzle rather long, thick in a vertical direction, but not broad; top of the head very slightly elevated; nostrils small, near together; ears of medium size, ovoid, with a distinct and regular notch near the middle of their outer margins; tragus narrow and tapering to an acute point, which is directed outwards; its outer margin has a notch near the base.

Wing-membranes extending to the base of the toes; the latter longer than the remaining part of the foot; thumb with the free portion much longer than that which is engaged in the membrane.

The fur of the forehead, which is very thick, extends uninterruptedly to halfway between the end of the nose and the eyes; all the side of the face from the root of the ear to the snout is naked, with the exception of a tuft of stiff hairs in front of the eye and a moustache on the upper lip. The ears are a little hairy at the base of their hinder surface, and the fur of the back encroaches a little on the interfemoral membrane.

Everywhere the fur is very thick, soft, and *cottony*, with very little gloss. That of the upper parts is tricoloured, and that of the under surface bicoloured.

On the top of the head and the whole of the back it is blackish brown at the base for a fourth of its length, succeeded by yellowish buff, and tipped with light rust-colour, the latter prevailing most on the shoulders and on the interfemoral membrane. All the under parts have the fur dusky at the base for half its length, the remainder being pale buff, and it is so thick and close as to appear wholly of the latter colour unless it be moved.

Individuals vary considerably in the hue of the rust-coloured and buff portions of the fur, so that their general appearance may be either light reddish buff-colour, or a medium brown; but in either case the bicoloured and tricoloured character of the fur is maintained.

The specimen of *V. emarginatus,* which formed part of the Italian collection of the late Prince C. L. Bonaparte, having been presented by him to me during a stay in Paris in the spring of 1857, I am enabled to correct an error into which I had fallen, with some other zoologists, in regarding it as referable to *V. Nattereri.* It is unquestionably the *V. emarginatus* of Geoffroy. This specimen, preserved as a skeleton, but a good deal injured, supplies the following details respecting the dentition*:—

In. $\frac{2-2}{6}$; Can. $\frac{1-1}{1-1}$; P. M. $\frac{1-1}{3-3}$; M. $\frac{3-3}{3-3}=\frac{14}{20}$.

* It may not be amiss to record here the exact condition of the specimens of

The dental series of the upper jaw when seen from below presents two straight and nearly parallel lines, the space between them being closed across the front opening by the transverse position of the incisors. They are so placed as to occupy nearly all the opening. Seen laterally they are nearly vertical; but when viewed in front, they slope so much inwards that the points of the inner ones nearly touch each other, and thus fill up nearly the whole of the interval between the two canines. The space between them and the canines is very small. The inner ones are rather large and deeply forked; the outer ones smaller and conical. The canines are short and stout, angular, and somewhat pointed. All the remaining teeth in the upper jaw are of the form common to nearly all the species of *Vespertilionidæ*.

The lower incisors are small, close together, and trilobed; the canines short and rather stout; and the three following teeth conical and increasing in size, the one next to the true molars being considerably larger than the two others, which are nearly equal. The molars present nothing remarkable in their form.

The following dimensions have been taken from three specimens in the Paris collection,—one from Charlemont, one from Abbeville, where it was collected by M. Baillon, and the third from a specimen obtained by M. Hollandre at Metz.

	1.		2.		3.	
	″	‴	″	‴	″	‴
Length of the head and body . .	2	10	2	9	2	8
——— of the tail	1	3	1	3½	1	2½
——— of the head	0	9	0	8½	0	9
——— of the ears	0	6	0	6½	0	6½
——— of the tragus	0	3½	0	3½	0	4
——— of the fore-arm	1	5½	1	5½	1	5
——— of the longest finger . .	2	6	2	7	2	6
——— of the fourth finger. . . .	2	0	2	0	2	1
——— of the thumb	0	3½	0	3½	0	3½
——— of the foot and claws . .	0	4	0	4	0	4
Expanse of wings	10	6	10	0	9	10

2. Vespertilio formosus, Hodgs.

V. formosus, Hodgs. Journ. As. Soc. Bengal, iv. p. 700, 1835.
Kerivoula formosa, Gray, Cat. Mam. Brit. Mus. p. 27, 1843;

Chiroptera presented by Prince Bonaparte, because they are the types of his descriptions in the 'Fauna Italica.' The species which I received were as follow:—*Vesp. emarginatus*, *V. Aristippe*, *V. vispistrellus*, *V. Cappacinii*, *V. miniopteris*, *V. Ursinii*, *Noctula leucippe*, *Pipistrellus Savii* ?, *P. noctula*, *P. alcythoe*, *Plecotus auritus*, and *Rhinolophus ferrum-equinum*, the names here given being those attached to the specimens. It appears that they had been prepared as skeletons, with the membranes and ears left attached, and had then been expanded on pieces of card-board and varnished, the skin and fur having been also attached to the card. In this state they had been placed in a portfolio prepared for their reception, which previously to passing into my hands had been subjected to sufficient pressure to crush and very much injure the specimens, the crushed parts being in some of them lost.

Cat. Mam. and Birds of Nepaul, presented by B. H. Hodgson, in Brit. Mus. p. 4, 1846.

Vesp. (*Kerivoula*) *formosa*, Horsf. Cat. Mam. Mus. E. Ind. Comp. p. 40, 1851.

V. rufo-niger?, Tomes, MSS.

Mr. Hodgson thus describes this species:—"Entirely of a bright, soft, ruddy yellow, with the digital membranes triangularly indented, blackish. Head conical; face sharp; muzzle and lips confluently nudish; the former anteally grooved, not above; the outer and inner ears acutely pointed, moderate, less than the head; teeth $\frac{2-2}{6}$, $\frac{1-1}{1-1}$, $\frac{6-6}{6-6}$; snout to rump $2\frac{1}{2}$ inches; tail 2; expanse $12\frac{1}{2}$.

"Nasal bones slightly convexed in their length, and unite easily with a low forehead."

The following is the description of the specimen deposited in the British Museum by Mr. Hodgson. The specimen is preserved in spirit; but the skull having been removed, renders the description less perfect than might have been wished:—

Nostrils rather small and approximate. Feet rather large, the toes taking up fully two-thirds of their entire length. Wing-membranes extending barely to the base of the toes. Thumb with the basal phalange short, the one between it and the small one bearing the claw, taking up the greater part of its length. Tail-tip wholly enclosed in the interfemoral membrane.

Membranes (when wet with spirit) translucent, and marked with reddish brown and dark brown, the latter occupying the triangular spaces between the digits, and the former appearing as narrow stripes on each side of all the bones of the wings—just as in *Kerivoula picta*.

Fur very thick, that of the under parts yellowish buff, that of the upper similar at the root and tipped with rust-colour.

The specimen included in Dr. Horsfield's 'Catalogue of the Mammalia contained in the Museum of the East India Company' affords the following particulars:—Muzzle rather produced, thick, but not broad; top of the head scarcely elevated above the line of the face; nostrils small, near together, opening sublaterally, and slightly tubular. Ears ovoid, emarginate at their outer margin; tragus long, slender, and tapering evenly to a moderately acute point, which is curved a little outwards. Wing-membranes extending to the base of the toes, barely; the feet large, the toes occupying fully two-thirds of their entire length. The basal joint of the thumb very short in relation to the length of the second.

Fur very thick and close, and *cottony* in texture; that of the upper parts yellow-buff, with the tips of the hairs conspicuously tipped with rust-colour; below, uniform yellow-buff.

The interfemoral membrane, the portions of membrane contiguous to the flanks, and all the parts in the immediate vicinity of the bones of the wings and legs, chestnut-coloured, all the remaining parts of the membrane being black-brown.

The following description has been taken from the specimen from Shanghai; and I may observe, that a specimen in my own collection, also from China (Kiang), is similar, but with the colours even brighter. As these examples differ from those already described in a few particulars only, save in colour, it will be necessary to mention merely these points of difference, and the remarkable colouring of the fur of this variety—if it is not a distinct species:—

Ears ovoid, nearly the length of the head, and more deeply and evenly notched near the middle of the outer margin than in the ordinary examples of *V. formosus*; tragus very narrow and tapering to a very acute point, curved a little outwards. The extreme tip of the tail free.

On all parts of the body the fur is thick and *cottony*, with very little gloss. That of the upper parts tricoloured, excepting on the head, where it is bicoloured. On the latter part it is buff at the base, tipped with very bright rufous; on the whole of the back it is blackish grey at the base, succeeded by buffy yellow, and finally tipped with bright rufous. The rufous colour is brightest on the head and shoulders, from which parts it becomes darker and less pure on approaching the rump. The hair which extends on to the base of the interfemoral membrane is unicoloured, and dark red-brown. On the whole of the under parts, the fur is bicoloured; that of the throat resembles that on the top of the head, being buffy yellow, tipped for about a fourth of its length with bright red. Along each side of the body, from the insertion of the humerus to the pubal region, it is similar to the throat; but the rufous colour occupies more than half the length of the fur. Along the middle of the belly it is dusky at the base, similarly tipped with a deep and brilliant rufous colour.

The membranes are very conspicuously marked with two colours, brown-red and black. The latter colour may be called the real colour of the wings; but a narrow space on each side of all the bones is of the former; of this brown-red colour also is the whole of the interfemoral membrane and the membrane between the index finger and the longest. Beneath the fore-arm, and from thence by the side of the body to the hinder limb, the red colour is of considerable breadth, attaining to as much as three-quarters of an inch. From this space it runs in dotted lines into the black colour of the wing, and produces great richness of appearance. The ears are red-brown, tipped and margined exteriorly with black. The feet also are black; but the legs and all the bones of the wing are of the same red colour as the contiguous membrane.

In the annexed table of dimensions, column No. 1 represents Mr. Hodgson's specimen in the British Museum, No. 2 the specimen in the East India Company's Museum, No. 3 the Shanghai specimen, and No. 4 the one from Kiang.

	No. 1.		No. 2.		No. 3.		No. 4.	
	$''$	$'''$	$''$	$'''$	$''$	$'''$	$''$	$'''$
Length of the head and body..	....		2	10	2	4	2	9
——— of the tail	2	0	1	6	1	8	1	9
——— of the head..........	....		0	9	0	$7\frac{1}{2}$	0	$8\frac{1}{2}$
——— of the ears	....		0	6	0	7	0	6
——— of the tragus	....		0	$3\frac{1}{4}$	....		0	$3\frac{1}{2}$
——— of the fore-arm	1	10	1	10	1	$9\frac{1}{2}$	1	10
——— of the longest finger ..	3	2	3	0	3	0	3	2
——— of the fourth finger ..	2	6	2	8	2	6	2	7
——— of the thumb........	0	$4\frac{1}{2}$	0	5	0	5	0	5
——— of the tibia..........	....		....		0	$10\frac{1}{2}$	0	11
——— of the foot and claws..	0	$5\frac{3}{4}$	0	6	0	5	0	$5\frac{1}{2}$
Expanse of wings	12	7	12	0	13	6	12	6

Although I have treated the Chinese specimens as varieties of the Indian species, I hold it by no means proved that my first impression was not the correct one. The differences may be thus summarily stated:—1. The ears of the Chinese examples are more deeply hollowed out exteriorly. 2. The tragus is more acute. 3. The tip of the tail is free. In the Indian specimens the ears are less strongly emarginate, the tragus is sub-acute at the tip, and the tail wholly enclosed in the membrane; at least it is so in the specimen in spirit. The great difference in colour may perhaps be due to the influence of climate.

Without a greater number of examples for examination, and especially without an investigation of their crania and dentition, it is difficult to decide with certainty whether this is merely a remarkable variety, or a distinct species. Should it however prove to be distinct, I propose for it the name I at first made use of to designate it, viz. *Vesp. rufo-niger*.

3. Vespertilio rufo-pictus, Waterh.

Vesp. rufo-pictus, Waterh. P. Z. S. pt. 13. p. 8, 1845.
Kerivoula rufo-picta, Gray, Zool. Voy. Samar. no. 5, 1849.

The original specimen from which Mr. Waterhouse took his description having passed into my hands at the dispersion of the Museum of the Zoological Society, I have been enabled to examine it attentively, and to compare it with Mr. Hodgson's specimen of *V. formosus* in the British Museum, from which it at first sight appears to differ only in being a little larger. On more careful examination it proves to be quite an immature individual, so that if full-grown it would probably differ considerably in size from that species. Again, the number of the teeth appears to be different—different at least from the account given by Mr. Hodgson of the dentition of *V. formosus*. He says, "Teeth $\frac{2-2}{6}$, $\frac{1-1}{1-1}$, $\frac{6-6}{6-6}$." I can only detect $\frac{5-5}{5-5}$ molars in the specimen of *V. rufo-pictus*, of which two on each side, above and below, are false molars.

The face is rather long and somewhat obtuse, but not much broader laterally than it is thick in a vertical direction; the top of the head

very little elevated; the nostrils small and near together, with the space between them slightly depressed rather than emarginate. The glands of the upper lip do not approach very closely to the edge of the latter, but pass backwards over the eyes almost to the front margins of the ears, and leave a central longitudinal depression along the face, up the middle of which is a narrow raised ridge, producing, to use the words of Mr. Waterhouse, "two longitudinal grooves." The ears are very similarly shaped to those of *V. formosus*, but I think a little less emarginate. The tragus has a distinct tooth or lobe at its outer margin, close to the base, above which is a considerable indentation, succeeded by an obtuse angle, from which it passes in a straight line to the tip, which is tolerably acute. The inner margin is nearly straight. Both the ears and tragus, when examined by transmitted light, appear to be glandular in structure.

The feet are large; the toes occupying fully two-thirds of their entire length. The *os calcis* takes up two-thirds of the distance between the foot and the end of the tail; the latter wholly enclosed in the interfemoral membrane. The middle phalange of the thumb (as in all others of the group) long, the basal one short.

The fur on the top of the head is thick, but does not extend so near to the end of the nose as in *V. formosus*. On the space around the eyes are some irregular tufts of longish hairs, and the upper lips are furnished with moustaches of bristle-like hairs; and all the upper surface of the snout, from above the nostrils to the fur of the forehead, is similarly studded with short bristly hairs.

The fur on the back extends on to the base of the interfemoral membrane for a fourth of its length, and along the tibiæ to the upper surface of the feet, the outer toe * being furnished with short bristly hairs on the whole of its upper surface, and the others hairy only on their terminal and subterminal phalanges. The interfemoral membrane has a series of similar short hairs on the whole of its hinder margin.

On all the upper parts the fur is close, firm in texture, and bicoloured; light dusky grey at the base, with the tips yellowish buff. Below, it appears to be unicoloured, buffy ash, with a strong tinge of yellow about the axilla.

It is probable that the fur would be more markedly bicoloured in older examples, as we see in other species that the colours of young specimens are much less distinct than in older ones.

The membranes are marked precisely as in *V. formosus*, and require no further notice.

Dentition.—In. $\frac{2-2}{6}$, Can. $\frac{1-1}{1-1}$, Premol. $\frac{2-2}{2-2}$, Mol. $\frac{3-3}{3-3}=\frac{16}{18}$.

Dimensions:—

	″	‴
Length of the head and body	2	6
——— of the tail	2	1

* The so-called outer toe of a Bat, with the members extended, corresponds with the inner toe of other Mammalia.

	"	'''
Length of the head	0	10
——— of the ears	0	6
Breadth of ears	0	5
Length of the tragus	0	$3\frac{3}{4}$
——— of the fore-arm	1	$11\frac{1}{2}$
——— of the longest finger	3	2
——— of the fourth finger	2	9
——— of the thumb	0	5
——— of the tibia	1	0
——— of the foot and claws	0	6
——— of the os calcis	0	$11\frac{1}{2}$
Expanse of wings	13	2

4. Vespertilio Pearsonii, Horsf.

Lasiurus Pearsonii, Horsf. Cat. Mam. Mus. E. Ind. Comp. p. 36, 1851; Blyth, Journ. As. Soc. Bengal, no. 6. 1851, p. 524.

This is much the largest species of the group, and probably if sufficiently examined would prove to be also the most characteristic. But at present I have only had the opportunity of examining three specimens, all in the state of skin; viz. the type of Dr. Horsfield's description, another in the same collection from Nepal, presented by Mr. Hodgson, and the third in the British Museum, from Amboyna. From these examples the following description has been taken, which will be followed by remarks on their individual differences.

The top of the head is rather flat, scarcely so much elevated as in *V. murinus*; the muzzle is also rather broad and obtuse, as in that species, and the nostrils have nearly the same form and proportions. The ears are as broad as they are high, very much rounded at the end, and with a distinct and evenly-defined notch, *scooped* in their external margin. They resemble the same parts in *V. emarginatus*, but are much broader in relation to their length, and less deeply hollowed out externally. As in that species they are thickly dotted with fine glandular spots. The tragus is narrow, and tapers to an acute point, with a slight outward curvature, and it is furnished with a projecting angular point at its outer edge near the base. It is rather more than half the length of the ear.

The wing-membranes extend to the base of the toes, and the latter are fully two-thirds of the entire length of the foot. The claws are strong and hooked. The thumb is very long, and its claw also large and hooked, more so relatively than in any of its congeners. The tip of the tail is free from the membrane.

The upper canines are very short, stout, and conical, with a blunt inner lobe; the lower ones are also stout and short, as are also the incisors, above and below.

The upper surface of the interfemoral membrane is more or less covered with hair, varying somewhat in different individuals, and the portions of the wing-membranes contiguous to the sides of the

back are also hairy. Beneath, the membranes are hairy only in close proximity to the vent and lower part of the body.

In texture the fur is soft, thick, and *cottony*, and rather long, that on the middle of the back being as much as 5 lines in length.

On the upper parts the fur is tricoloured, as in the other members of the group. That of the back has the base dusky, succeeded by yellowish grey for the greater part of its length, and the remainder rufous brown, with the exception of the extreme tips of the hairs, which in the type specimens are paler and shining; the general colour of the fur of the upper parts, when undisturbed, being a dull rufous brown, excepting that on the interfemoral membrane, which is of a somewhat brighter rufous tint, and uniform in colour for its whole length.

The general tint of the under parts is palish brown, each hair being reddish brown for the greater part of its length, with shining tips of the same colour, but paler. The shining tips are most observable on the breast, and least so on the pubes.

Mr. Hodgson's specimen differs only from the type specimen in the absence of the shining tips to the fur. In both of these the membranes are reddish brown, with *the portions contiguous to the bones of the wings somewhat diaphanous, and corresponding pretty accurately with the red parts in* V. formosus.

The specimen from Amboyna differs so considerably in colour, that it will be well to give a description of it separately.

The interfemoral membrane has about twenty-four strongly marked transverse dotted lines; and about ten or twelve similar ones may be seen on the base of the wings, parallel to the body.

On the whole of its upper surface the interfemoral membrane is clothed with hairs, but not very thickly, excepting on the *os calcis*, which is thickly fringed, as are also the feet; the membrane contiguous to the back is also similarly furnished with hair. The under surface of the membranes contiguous to the body, *i. e.* from the axilla, by the flanks and around the pubes, is also clothed with hairs, which thin off gradually, and are lost at the distance of a little more than half an inch from the body.

The whole of the fur is of the same peculiar texture observed in the other examples, fine, and of medium length. On all the under parts of the body it is purple-brown at the base, for a third of its length, succeeded by purplish white, and tipped with bright rust-colour. That which extends on to the upper surface of the membranes is of a uniform rust-colour, and the face is wholly rust-coloured. Beneath, all the fur is of a brownish-white colour, tinged with rufous on the shoulders.

The membranes are dark reddish brown, the interfemoral, and those parts which are red in *V. formosus,* being of a lighter and redder tint, but not so well marked as in that species.

The following are the dimensions of these examples; 1. the type specimen of Dr. Horsfield, 2. Mr. Hodgson's specimen, and 3. the one from Amboyna :—

	1.		2.		3.	
	″	‴	″	‴	″	‴
Length of the head and body..	3	1	2	6?	1	6
——— of the tail	1	8	0	7?	1	4½
——— of the head..........	0	11	0	10?	0	6½
——— of the ears	0	6	0	5½	0	5½
Breadth of the ears	0	6	0	5½	0	3¼
Length of the tragus	0	4	0	3½	0	3
——— of the fore-arm	1	10	1	8	1	5
——— of the longest finger ..	2	8	3	4	2	2½
——— of the fourth finger....	2	8	2	7	1	10
——— of the tibia	0	11	0	9	0	7
——— of the thumb	0	7	0	6		
——— of the foot and claws ..	0	5	0	5	0	4½
——— of the *os calcis*	0	9	0	8		
Expanse of wings............	13	7	13	4	9	3

Vespertilio Madagascariensis, n. s.

The species which I have thus named, although not appertaining to the restricted group which forms the subject of the present paper, is nevertheless a true *Vespertilio*. It is properly a member of the restricted group which is represented by *V. mystacinus*, *V. polythrix*, *V. Chiloensis*, *V. ruber*, *V. Isidori*, *V. Hilairii*, *V. parvulus*, *V. trilatitius* (Temm. not Horsf.), and some others. As the first of these is the best-known species, I shall take it as a standard for comparison, and at the same time refer to any points of greater resemblance which the new species may have to others less known.

It is of about the same size as *V. Daubentonii*, but differs from it in other respects considerably. The top of the head is somewhat elevated, as in *V. mystacinus*, and, as in that species, the muzzle is rather short and pointed. The nostrils are small, near together, sublateral in their direction, and the space between them emarginate. The ears are of medium length, rather broadly ovoid, and deeply emarginate about the middle of the outer margin; but the notch has not the appearance of being *scooped* out, as in the species previously described in the present paper. It is in fact just as in *V. mystacinus*, but deeper. The tragus is about half the length of the ear, narrow and pointed, and curving slightly outwards. It has a prominent angle on its outer margin near to the base.

The thumb is small, and the two visible phalanges are of nearly equal length. The wings are proportioned much as in *V. mystacinus*. The feet are relatively rather large as compared with those of that species, but much less so than in *V. Daubentonii*, and the wing-membranes extend nearly *to the base of the toes*, the latter being of nearly equal length. The extreme tip of the tail is free.

The face is densely hairy, only the end of the nose and a small space between the eyes and ears being naked. On the upper lip are moustaches of long hair, and there are a few similar long hairs projecting from the chin. The ears are somewhat hairy on their outer surfaces, at the base only. All the membranes are naked.

The fur is thick and soft, with very little lustre, in texture very like that of *V. Chiloensis*. That of the upper parts is nearly unicoloured, of a deepish ferruginous hue, a little darker at the root than at the tip. Below, it is bicoloured, dark brown at the base, tipped with greyish brown, paler and unicoloured on the pubes.

The dentition has not been examined.

	"	‴
Length of the head and body, about	2	10
——— of the tail	1	$5\frac{1}{2}$
——— of the head	0	$7\frac{3}{4}$
——— of the ears....................	0	5
——— of the tragus....................	0	3
——— of the fore-arm....................	1	5
——— of the longest finger..........	2	7
——— of the fourth finger	1	10
——— of the thumb	0	3
——— of the tibia	0	$7\frac{3}{4}$
——— of the foot and claws	0	$4\frac{1}{4}$
Expanse of wings	10	2

BOTANICAL SOCIETY OF EDINBURGH.

March 11, 1858.—Professor Balfour, V.P., in the Chair.

The following papers were read:—

1. "A few Remarks on the Application of Photography to Botanical Purposes," by Charles J. Burnett, Esq.

2. "Critical Remarks on the genus *Orthotrichum* (Part II.)," by Dr. Benjamin Carrington.

In this second part of his paper, Dr. Carrington gave a detailed description of the various British species of *Orthotrichum*, and entered upon a discussion of their specific distinctions, especially with reference to those species that have of late years been added to the British flora.

3. "Recent Botanical Intelligence," by Professor Balfour.

I. *Gutta Percha of Surinam.*—Prof. Bleckrod of the Delft Academy has recently given a notice of the Gutta Percha of Surinam. The Professor states that Dutch Guiana can supply gutta percha. The Dutch Government took measures to transplant the *Isonandra Gutta* and cultivate it in Guiana; but they have lately discovered in that country a species of *Sapota*, to which Blume gives the name of *Sapota Mulleri*, which yields a juice in every way equal to that of the *Isonandra*. It is probable that other trees of the same natural order may be found to yield a similar product. *Achras Sapota*, the fruit of which is known in the West Indies as "Neesberry," also yields a milky juice like gutta percha. The *Sapota Mulleri* of Blume is probably the tree called "Bullet-tree" by the English, and its wood is known as "horse-flesh." It is a tall tree, yielding in summer a large quantity of milky juice. It appears that, under the name of common Boerowe or Bullet-tree, there have been confounded—

1. the *Lucuma mammosa* of Gaertner (Marmalade-tree), the *Mimusops* of Schomburgk; 2. the White Boerowe, which is the *Dipholis salicifolia* of Alph. DC., and is known in Jamaica as Galimata; 3. the Bastard Boerowe, or Lowranero, which is the *Bumelia nigra* of Swartz; and 4. the Neesberry Bullet-tree, or *Achras Sideroxylon* of botanists, which yields one of the best of the Jamaica woods. *Sapota Mulleri* grows abundantly on slightly elevated situations. In collecting the milk, the trunk is surrounded with a ring of clay, with elevated edges, and then an incision is made in the bark, as far as the liber. The milky juice flows out immediately, and is collected in the clay reservoir. The juice resembles in some respects the milk of the cow; it forms a pellicle on its surface, which is renewed after removal. By the evaporation of the juice, we obtain 13 to 14 parts in 100 of pure gutta percha. Six volumes of absolute alcohol, added to ten of the juice, separates at once all the gutta percha which it contains. Sulphuric æther acts more rapidly than alcohol. The juice is not coagulated by acetic acid. This Surinam gutta percha is said to be sold at Amsterdam at the same price as the best gutta percha of commerce.

II. *Vegetation around the Volcanic Craters of the Island of Java,* by M. H. Zollinger.—DeCandolle, in his 'Géographie Botanique,' has omitted to notice among vegetable stations those around volcanic craters. In Java there are more than sixty of these craters, all isolated and surrounded by vast virgin forests. When the craters are active, and send forth lava (which is not the case with the Javanese volcanos), or cinders, or sand and fragments of rock, or when they exhale continually vapours and gases, then there is no vegetation except some *Oscillariæ,* which are found in hot-water springs. It is only when the direct volcanic action is diminished by the effect of time, or the distance of the crater, that a special vegetation appears. The craters of the Indian Archipelago are characterized by the absence of all parasitic or epiphytic plants, as well as of climbing and twining plants. Woody plants only appear at a considerable distance from the craters. We can easily distinguish three different regions: 1. an interior zone, nearest to the centre of volcanic action; 2. a middle zone, surrounding the first; 3. an exterior zone.

1. *Interior zone.*—This exhibits mostly small species, scattered here and there, belonging to the lower orders of plants, and to those having no corolla. Among these are—*Oscillaria labyrinthiformis,* Ag.?, in warm springs; *Cladonia macilenta,* Hoff., and *Bacillaria obtusa,* Schær.; some Fungi belonging to the genus *Polyporus*; a *Marchantia*; two or three species of Mosses; some Ferns, such as *Selliguea Feii,* Borg.; *Polypodium triquetrum,* Bl.; *Asplenium macrophyllum,* Bl.; *Asplenium mucronifolium,* Bl., and *Gleichenia vulcanica,* Bl. Among the Cyperaceæ, *Phacellanthus multiflorus,* Steud.; and *Polygonum corymbosum,* Bl., is the only Dicotyledon.

2. *Middle region.*—Many social Ferns occur here, some Dicotyledons, for the most part small shrubby plants. Among the Ferns are—*Polypodium Horsfieldii,* R. Br., 3000 to 8000 feet; *Pteris aurita,* Bl.; *Blechnum pyrophilum,* Bl.; *Gleichenia ferruginea,* Bl.;

Mertensia longissima, Kze.; *Lycopodium spectabile*, Bl.; *L. trichiatum*, Borg. We also meet still with *Phacellanthus multiflorus*, a *Carex*, *Polygonum corymbosum*, and *Imperata arundinacea*. A species of *Antennaria* and *Anaphalis*, among Composites; and certain Ericaceæ appear; also *Leontopodium*; *Elsholtzia elata*; *Wahlenbergia lavandulæfolia*, DC.; *Ophelia javanica*; *O. cærulescens*, Zoll.; *Melastoma setigerum*, Bl., the cells of which are said by M. Zollinger to contain crystals of pure sulphur; *Medinilla javensis*, Bl.; *Rubus lineatus*, Reinw.; besides other genera and species.

3. *Exterior region.*—This region gradually loses itself in the ordinary forest vegetation. Some rare Mosses, Ferns, and Orchids appear at the outer portion of the region. Among other plants may be noticed *Synœcia* (*Ficus*) *diversifolia*, Mig.; *Rhododendron javanicum*, Reinw.; *Agapetes elliptica*, Don, &c. Amongst the common arborescent plants may be mentioned *Agapetes varingiæfolia*, Don, and *Myrsine avenis*, Bl. The beautiful *Albizzia montana*, Bth., a social plant; *Casuarina montana*, Lesch., and *C. Junghuhniana*, Mig., are on the outer part of the region. We find also here an arborescent *Bœhmeria* and a dwarf *Epilobium*. Some twining plants form transition species, such as *Nepenthes gymnamphora*, Bl., and some varieties of *Polygonum corymbosum*. The order Ericaceæ is the predominant one. The genus *Rubus* is well represented. The Orchid that approaches nearest the craters is *Thelymitra javanica*, Bl.

III. *The Lotus or Sacred Bean of India.*—Dr. Buist gives some notes on the Lotus or Sacred Bean of India in the Transactions of the Bombay Geographical Society. Dr. Lindley is mistaken in saying that the wicks used on sacred occasions by the Hindoos are made of the spiral vessels of the leaves of the Lotus. They are formed, he says, of the dried flower or leaf-stalk. Dr. Buist does not believe that all the spirals of all the Lotuses in India, from the Himalayas to the Line, would make a lump of wick a yard long the thickness of the finger. Individually, the spirals are finer than gossamer; the leaf is 14 to 16 inches in diameter; the stalks about 6 to 8 feet long, and seldom rise higher than 2 or 2½ feet above the surface of the water. The leaf is buoyant enough to support a crow, and is frequently made use of by that bird as a fishing station, from which flies, snails, or water-lizards are preyed upon. The flower has something of the smell of the Tonquin bean, or the blossom of the bean. The upper surface of the leaf is a deep green.

MISCELLANEOUS.

Prof. Owen's Lectures on Palæontology.

The ninth Lecture, on Oolitic Crocodiles, delivered on the 29th April, concluded as follows:—

Since the publication of the remarks on the cranial structure of the Whitby Teleosaur in my 'Report on British Fossil Reptiles,' of 1841, I have had many opportunities of studying the osteology of

the head in that and other species of *Teleosaurus* from British strata, especially of remarkably perfect skulls obtained by H. Moore, Esq., from the Lower Oolite of Somersetshire.

The following is the cranial structure in the *Teleosauri*, according to my present knowledge.

The occipital region, as in modern Gavials, is very broad in proportion to its depth. The foramen magnum is the sole vacuity in its bony wall, and is bounded by the ordinary occipital elements; the hind surface of the skull is completed by the parietal, the mastoids, and the tympanics.

The basioccipital developes the main part of the condyle, which forms somewhat more than the lower half of a hemisphere; the two upper angles being contributed by the exoccipitals. Near the upper part, which enters in a small degree into the formation of the great foramen, the condyle usually shows a small central pit. Below and in advance of the condyle, the basioccipital expands and bifurcates into two very short and thick diverging hypapophyses with rough truncate terminations; their bases converge forwards, forming the sides of a deep groove, at the fore part of which are two orifices leading to air-cells in the basioccipital.

The broad extended bases of the exoccipitals articulate with the sides of the condyle and of the hypapophyses of the basioccipital, and, after a slight contraction, each exoccipital rapidly expands and branches into three short and broad processes. The upper and inner one curves upwards and inwards to complete the periphery of the foramen magnum by uniting with its fellow above that aperture. The second extends outwards, and forms the compressed horizontal plate articulating with the lower and hinder part of the ridge of the mastoid: a vascular foramen and a deep and smooth notch divide this from the lower and third process, which represents the paroccipital: this part articulates by a broad overlapping sutural surface with the tympanic.

The groove dividing this surface from the paramastoid process is the back part or wall of the meatus auditorius.

The exoccipital thus articulates with its fellow and the superoccipital above, with the basioccipital below, and with the mastoid, alisphenoid and tympanic externally. Its internal surface is smoothly excavated, posteriorly, for the epencephalic cavity, and irregularly excavated anteriorly for the acoustic cavity. The epencephalic surface is perforated by small foramina for the roots of the ninth nerve.

The superoccipital is a depressed transversely extended bone, with an outer vertical subrhomboid surface: it articulates by broad sutures to the exoccipitals below and to the parietal above: the under surface, in advance of the exoccipital suture, is smoothly and deeply excavated, to form the roof of the epencephalic chamber; the sides of the bone are excavated by sinuses from the acoustic chamber.

In regard to the occipital elements, the Teleosaur differs from the Gavial in the division of the hypapophyses, and hereby more resembles the Lizards than the Crocodiles, in which the two processes are blended together in a thick descending mass: the paroccipital is

equally developed with the paramastoid in the *Teleosaurus,* in which the latter process stands out clear of the tympanic: in the Gavial and modern Crocodiles, the paramastoid is much more developed than the paroccipital process, and it also articulates with the tympanic. In both the Teleosaur and Crocodile, the paroccipital process is divided from the paramastoid process of the exoccipital by the groove which forms the back wall of the meatus auditorius.

The basisphenoid presents a moderately extended, smooth and free or non-articular inferior surface, divided by a median ridge: each half of the surface contracts as it rises outwards, and is concave. The posterior angles of the basisphenoid are wedged into the fore part of each hypapophysis of the basioccipital, the rest of the posterior surface of the basisphenoid having a broad sutural union with the basioccipital. The upper and hinder part of the sides of the basisphenoid articulate with the alisphenoids; below and in front of this articulation is the sutural surface for the pterygoid: the upper surface of the basisphenoid forms the floor of the mesencephalon: its substance is largely excavated by productions of the auditory chamber.

The alisphenoid contracts a little after it rises from the basisphenoid, being notched behind for the meatus, and in front for the trigeminal nerve: it then rapidly expands in antero-posterior extent, but ends about half-way up the temporal fossa, uniting with the parietal above, the orbitosphenoid in front, the mastoid and exoccipital behind: below it articulates chiefly with the basisphenoid and a little with the pterygoid.

The parietal is a single, symmetrical, elongate-quadrate bone, contracted at the middle, with the angles produced. Posteriorly it forms the upper ridge of the occipital surface, overhanging the superoccipital, and overlapping the inner ends of the mastoids. The upper surface is extensively impressed by the crotaphyte surface: a very narrow longitudinal tract, becoming in old *Teleosauri* a ridge, divides these surfaces. The lower boundary offers two wide and shallow emarginations, the dividing angle projecting into the suture between the ali- and orbito-sphenoids. The anterior border is notched on each side to receive a process from each frontal. The under surface of the parietal contributes a narrow, elongated, slightly concave tract to the upper wall of the cranium. The parietal rests almost equally on the ali- and orbito-sphenoids.

The mastoid is a triradiate bone; its shortest ray descending obliquely outwards and backwards, to terminate the strong ridge for muscular attachments formed chiefly by the exoccipital: the broadest ray extends forwards, forming the hinder half of the upper zygoma: the sharpest and longest ray extends upwards and inwards to form the outer and greater part of the superoccipital ridge, which sharply divides the occipital from the temporal surface. The zygomatic part of the mastoid is sculptured on its outer surface. The mastoid unites with the parietal, alisphenoid, exoccipital, tympanic, squamosal and postfrontal: it forms the angles of the back part of the skull, and knits strongly together the contiguous bones.

On comparing the parietal segment of the skull in the Teleosaur and existing Crocodiles, the first difference to be noted is the greater proportion of the external surface of that region of the skull which is contributed in the Teleosaur by the basi- and ali-sphenoids: they maintain more of their normal shape and proportions in the ancient Crocodiles. In the modern ones the lower surface of the basisphenoid is little more than the edge of the wedge, just expanding enough at its middle to contribute part of the eustachian outlet, with a scanty portion of a free smooth surface, on each side, in the Gavial. The alisphenoid in modern Crocodiles has the whole of its outer surface broken up into irregular parts of the auditory cavity: it offers no surface of attachment for the crotaphyte muscles. The sides of the parietal descend much lower, to compensate for the restricted outer expansion of the alisphenoid. The parietal is much shorter, has a broad and flat sculptured quadrate surface between the temporal fossæ; and the posterior margin does not overhang, but is a little in advance of the superoccipital.

The Gavial differs from the Crocodile in the greater outward production of the posterior angles of the parietal, and in that respect more resembles the Teleosaur. The parietal of the Teleosaur retains more of the normal type: it is not, however, perforated as in Enaliosaurs and Lacertians.

The presphenoid is represented by a pointed styliform compressed production of the basisphenoid.

The orbitosphenoid is of great fore-and-aft extent, deeply excavated internally where it forms the side of the widest part of the cerebral cavity, protecting, as in the Crocodile, the cerebral hemispheres: externally the bone is convex vertically, concave lengthwise; expanding anteriorly to form the back part of the orbit, uniting with the parietal and frontal above, with the alisphenoid behind, and with the basi-pre-sphenoid below.

Traces of the frontal suture remain longer in the Teleosaur than in the Crocodile, especially on the inner surface; but the frontal is a single bone long ere the Teleosaur is adult. It is of an elongate subhexagonal form, the long lateral borders emarginate for the orbits: the posterior border is notched at the middle, and is impressed on each side of the upper surface by the fore part of the temporal fossæ: the broad interorbital tract is flat: the inferior cerebral surface is long and narrow, bounded laterally by moderately curved sharp vertical ridges, convex towards each other, concave towards the orbits.

In modern Crocodilia the vertical diameter of the orbitosphenoids exceeds the longitudinal one: the frontal is not impressed by the temporal fossæ, and the interorbital space is concave through the elevation of the upper borders of the orbits.

The postfrontals have their sculptured outer surface almost vertical in the *Teleosaurus:* it is horizontal in modern Crocodilia: in the Teleosaur it is produced much further back, and forms a larger proportion of the upper zygoma: it is also continued upon the descending process which joins the malar, whilst in modern Crocodilia

this process is smooth, and is more or less overhung by the sculptured horizontal surface of the postfrontal. In this respect the Teleosaur manifests its more general or lacertian character.

The prefrontals have a short, broad, facial plate, and appear to have had a much shorter descending neurapophysial plate than in modern Crocodiles; their orbital border is not produced or raised, as in the Gavial.

The nasals are relatively broader behind than are those of true Crocodiles and Gavials, and resemble the latter in their non-extension to the anterior nostril; their proportion, as to length, much resembling, in *Teleosaurus latifrons*, that of the nasals in the *Gavialis gangeticus*. They overlap a considerable extent of the bifurcated anterior end of the frontal.

The premaxillaries are shorter in proportion than in the Gavial; but, as in that animal, they wholly surround the external nostril, which is terminal, and its plane nearly vertical, instead of being horizontal. The end of the muzzle, so formed, is less expanded than in the Gavial; so that the Teleosaur must have been able to breathe by protruding from the surface of the water a much less proportion of the muzzle than the Gavial does; but it must have raised the head more obliquely in the act.

The maxillary bones are of great length. They unite with each other above, along a tract varying in length in different species, between the premaxillaries and nasals; they unite behind with a great proportion of the nasals, with the lacrymal, and with the malar.

The lacrymal extends much more forward than the prefrontal, being continued, in a pointed form, in advance of the small vacuity, or quasi-nostril, which is left between the nasal, the lacrymal and maxillary.

The malar, which begins below this vacuity, without entering into its formation, has its narrow anterior part wedged between the lacrymal and the palatal process of the maxillary: it bounds the lower part of the orbit, joins the broad descending process of the postfrontal, and is continued, as a straight slender bar, to join, underlapping, the lower end of the squamosal, completing with this bone the lower zygoma. Neither the lacrymal nor the malar develope any outstanding plate where they form the orbit.

The squamosal is a very small bifurcate bone: its back part unites with the outer side of the tympanic condyle, whence the larger branch extends obliquely upwards and forwards to the junction of the mastoid and prefrontal; the lower and shorter branch extends directly forwards, overlapping the hind end of the malar.

The bony palate is imperforate where it is formed by the premaxillaries, maxillaries, and fore part of the palatines: these latter bones are broader and flatter than in the Gavial: the vacuities between them and the ectopterygoids are narrower in the Teleosaur: but the most important modification of this part of the skull in comparison with modern Crocodilia, is shown in the much larger relative size, more advanced position, and more horizontal plane of the true internal or posterior nostril; which is surrounded, not in every species

exclusively by the pterygoid, but having its pointed anterior end produced between the diverging hind ends of the palatines.

The eustachian outlet, regarded by Professors Bronn and De Blainville as the true posterior nostril, is shorter and wider than in the Gavial: the posterior primary division of the eustachian canal penetrates the basioccipital and expands there into a subcircular sinus: the anterior primary division perforates the substance of the basisphenoid and ascends obliquely forwards a little way before bifurcating to form the anterior canals leading to the right and left tympanic cavities, which are extended by the production of its air-cells across the basioccipital and basisphenoid, and upwards into the tympanic, mastoid, alisphenoid, exoccipital, superoccipital, and parietal bones.

The temporal fossæ vary in shape in different species of *Teleosaurus*, being subquadrate in *Tel. latifrons* and *Tel. Cadomensis*, oblong in *Tel. Chapmanni* and *Tel. brevior*; but they are always relatively larger and with the upper outlets closer together than in the Gavial. In most old and large *Teleosauri* the parietal is reduced to an intermuscular crest between them; as is the mastoid, between their back part and the occipital fossa. In general the upper zygoma is on a lower level than the parietal, not as in modern Crocodilia on the same level. The orbits, of a full oval form, look more outwards than upwards; their rim is sharp, and not raised above the level of the rest of the skull.

The true external nostril is single, as in other Crocodilia; but is terminal, as above mentioned.

Rudiments of the divided nostrils, situated as in *Ichthyo-* and *Plesio-sauri*, a little in advance of the orbits, are present in most *Teleosauri*. I conjecture that they were not used as nostrils, but are a typical retention of a structure, indicative of the closer affinities of the *Teleosauri* to the *Nothosauri* and *Enaliosauri*.

The modifications of the cranium of the Teleosaur, compared with the modern Gavial, all bespeak its better adaptation for swiftly cleaving the liquid element. The upper jaw, not suddenly, but gradually, expands into the orbital region, and is not marked off by any outstanding plates of prefrontal, lacrymal, or malar. The cranium behind the orbits, moreover, goes on expanding to the occipital plane, instead of contracting, or retaining its sides parallel, as in the Gavial. The sloping of the sides of the temporal region, where it is formed by the broad upper zygoma, is another modification which would favour the progress of the head in a movement tending to roll it from side to side, as it was pushed through the water. The diminished expanse of the premaxillary end of the muzzle in the same degree decreases the resistance of this part during aquatic progress. All these cranial modifications harmonize with the amphicœlian vertebral column, the very small fore limbs, and comparatively large hind limbs in a crocodile organized for marine existence.

The lower jaw presents the same complex structure as in modern Crocodiles; a large vacuity also intervenes between the subangular, angular, and dentary elements. The ramus is of relatively greater depth at this part in some *Teleosauri*, e. g. *T. brevior*, than in the

Gavial. In *Tel. brevior* and in *Tel. latifrons*, the rami unite to form a symphysis as extended as in the Gavial; but in some other species, *Tel. temporalis*, e. g., the free portion of the ramus is longer.

The teeth of the *Teleosauri* are more numerous, more slender, less compressed and more sharply pointed, than in the Gavial; they are slightly recurved, and the enamelled crown is traversed by more numerous and better defined longitudinal ridges, two of which, on opposite sides of the crown, are more produced than the rest. The fang is smooth, cylindrical, and always excavated at the base.

The teeth of the *Steneosauri* are thicker in proportion to their length, and larger and fewer in proportion to the jaws; but their transverse section is also, as in *Teleosauri*, more circular, or less elliptic, than in the Gavial. In both genera of Liassic and Oolitic Crocodiles, the teeth have a closer resemblance to those of the *Notho-*, *Pisto-*, and *Plesio-saurus* than the teeth of modern Gavials have. In these the modification consists in the compression of the crown, rendering the opposite ridges trenchant edges.

In *Teleosaurus Chapmanni* I have counted $\frac{46-46}{48-48}=188$ teeth: in *Tel. latifrons* $\frac{36-32}{38-38}=144$ teeth: in *Tel. Egertoni* $\frac{39-39}{38-38}=154$: Cuvier has assigned to the *Tel. Cadomensis* $\frac{45-45}{45-45}=180$ teeth. The above formulæ will not be found constant in different individuals of the same species, by reason of the uninterrupted and irregular shedding and replacement of the teeth; but the numbers indicated in the British fossils are those of the sockets, some of which always appear empty. When these, however, have been scrutinized, they have given evidence that the same law regulated the succession of the teeth at the ancient period when Crocodilians prevailed in greatest numbers and under the most varied generic and specific modifications, as at the present day, when they are reduced to a single procœlian family, forming, as Linnæus believed, a small section of his genus *Lacerta*.

Comparing, agreeably with the principle which has governed my illustrations in the present Course of Lectures, the present and past forms of Crocodilians, I would say that, in the modern Gavial, the two lower processes of the basioccipital have become blended into one descending mass of bone: the paramastoid has been developed at the expense, as it would seem, of the paroccipital process. The basi- and ali-sphenoids become contracted, and cease to present those proportions of the external surface which they do in the more typical Teleosaurian skull: the parietal, by way of compensation, descends lower down the temporal fossæ; but it is much restricted in length, and more flattened above. Every trace of those vacuities which hold the position of the pair of nostrils in the Plesiosaur has disappeared in modern Crocodilia. Their sole external nasal aperture is somewhat raised upon the upper surface of the end of the snout, so that, with the head parallel with the surface of the stream, the nostril alone can be raised to inhale air, or can be lifted out of the water at the same time that the high-placed prominent eye is

opened above the surface of the water. The border of the orbit is raised for that purpose, so as to bring the eye to the summit of the head in modern Gavials and Crocodiles,—conditions for speedy progress through water being sacrificed for other advantages, necessitated perhaps by the more formidable enemies that modern Crocodilia have to encounter, as compared with ancient ones, and by the frequent position of those enemies on dry land. With the *Teleosauri*, the danger would come most probably exclusively from *Cetiosauri* or huge *Ichthyosauri* cleaving the same element. Accordingly the eyes looked outwards rather than upwards, and the outer surface of the head was evenly shaped and expanded to concur with other modifications of their frame for swift natation.

As we discern, therefore, in the upraised orbits of modern Crocodilia, their advantage in being able to peer abroad and scan the banks of their stream with the least possible exposure of their head, and connect that advantage with the position of the formidable enemy to which they are now exposed ; so, likewise, we discern in the shortening and expansion of their jaws, the enlargement and strengthening of their teeth, and the development of certain of these into canine-shaped tusks, a relation to a source of food in the coexisting Mammals, which would seem not to have existed for the *Teleosauri* ; if, indeed, large quadrupeds of the Mammalian class coexisted at all on the land washed by the ancient seas in which the *Teleosauri* seem habitually to have dwelt.

The pterygoids in modern Crocodiles are so developed in breadth and length as to carry back the inner nostril much beyond its position in *Teleosauri* ; and the pterygoids are united together to such an extent as much to reduce the size of that aperture. This contracted posterior nostril is associated in modern Crocodiles with a peculiar development of the base of the tongue and soft palate, which shuts off all communication between the cavity of the mouth and the air-passage from the nose to the windpipe. Hence, while the crocodile is holding under water a struggling and drowning quadruped, the water in the mouth of the crocodile cannot flow into the glottis ; and, if the raised nostril on the upper surface of the skull be protruded, air can be inhaled into the lungs without any need for relaxing the grip of the prey and closing the mouth. Supposing the *Teleosauri* to have subsisted exclusively on fishes or aquatic animals, as the gavial-like length and slenderness of their jaws and their numerous sharp serial teeth would indicate, such departure from type as the pterygoid developments in modern Crocodilia would not be needed ; and we again discern in the latter their relation to the higher forms of animal life with which those Crocodilia are now associated.

And these indications collaterally bear very significant evidence against the inference, based on the insecurity of negative evidence, that Mammalian life may have been as rife in Oolitic and Liassic times as at present, only not yet discovered.

On the Teeth of the Black and Wood Shell Slugs.
By Dr. J. E. Gray, F.R.S. &c.

Razoumowsky, in his Natural History of Jorat, and Sturm, in the German Fauna, separated the Black Shell-slug as a distinct species, the first under the name of *Limax ater*, and Sturm under that of *Limax cinereo-niger*. Férussac regarded it only as a black variety of *Limax cinereus*, and most authors, except Nilsson, have followed his example. Herr Otto Goldfuss, in a paper on the Land and Freshwater Mollusca of the Rhine Province and Westphalia, has proved, by the examination of the teeth, that the German Black Slug is quite distinct from the usual streaked *Limax cinereus*: the teeth in the latter are thick, conical, acute, and quite simple; while in the black species they are slender, subcylindrical, attenuated to a fine point, and have a strong denticulation or notch on the front side, at some distance below the tip.

I may further observe, that the teeth of *Limax sylvaticus*, which has been considered as a doubtful species, and which Férussac thought was a variety of *L. agrestis*, are, according to the same author, exceedingly unlike the teeth of any other European Slug. The upper process of the tooth in this species is short, cylindrical, truncated, and rounded at the tip; while in all the others it is tapering and acute.

It is desirable that the teeth of English specimens should be examined, to find if the same difference exists in those species natives of this country.

This is an example of what I have long believed,—that the teeth afford very good characters for the separation of allied species, as well as for the distinction of genera and families. Such examples have long made me feel that we should be very cautious in considering specimens which are similar in the form of the shell and general appearance of the animal, as the same species, when they come from different localities and are said to have different habits, unless we have examined the teeth and other characteristic parts; and such facts as the above must always render the identification of fossil shells with recent species very problematical.

Note on the Anatomy of Cyclostoma elegans. By E. Claparède.

The most remarkable peculiarity presented in the anatomy of *Cyclostoma elegans* is the presence of an organ, of a brilliant white colour, lodged among the convolutions of the intestine. This organ, which has no analogue in any other known mollusk, contains a multitude of solid concretions, of concentric structure, composed of an organic skeleton and incrusting salts. The salts consist in part of carbonate of lime, partly of a salt not chemically determined, soluble in hydrochloric acid. This salt is not an oxalate; for it is also soluble, after a time, in acetic acid. An analogous gland exists in the *Cyclostoma costulatum* of the Banat. The author ascertained that the stiff silky hairs which are found on the skin of the freshwater Neritina exist in most of our freshwater Mollusca (*Lymnæa, Planorbis, Bithynia*).—*Müller's Archiv*, 1858, i. p. 1.

On the Fecundation of the Crustacea. By M. Coste.

In most of the species of Decapod Crustacea, the first two pairs of abdominal feet serve as appendages to the internal generative organs, and form a special apparatus, the function of which has not hitherto been thoroughly known. The Cray-fish preserved in the basins of the Collége de France have allowed M. Gerbe to ascertain this function. During copulation, these two pairs of appendages are erected, tending backwards and a little outwards. The posterior pair engages its foliaceous extremity in the twisted channel presented by the anterior pair; and the extremity of the deferent canal becoming evaginated in the form of a penis, between the appendages thus united, but moveable upon each other, pours out the seminal matter at their base. As it is excreted, this matter flows slowly along the deep furrow of the first appendages, and is deposited by them upon the sternum of the female, where it becomes concreted, acquiring vermicular forms.

As the seminal matter of most Crustacea, and especially of the common Cray-fish, is dense, and becomes rapidly solidified when in contact with water, the horny channel through which it runs would be easily obstructed, if the spoon-like extremity of the posterior piece were not adapted to clear it by repeated forward movements at each emission of semen.—*Comptes Rendus,* March 1, 1858, p. 432.

On the Dorsal Cavity of certain Ammonites. By Professor Quenstedt.

Notwithstanding the numerous investigations which have been made upon the Ammonites, there still remain some points to be explained with regard to them; and until this has been done, no precise determination can be effected of a great number of species. M. Quenstedt had long since observed in many casts, along the siphon, a cord, without septa, which is easily detached. His observations upon the *A. Truellei,* D'Orb., from the lower oolite of Moutiers, led him to the following results. Large fragments of this Ammonite show that the ferruginous oolite has penetrated into the dorsal cord, which would only be possible if this cavity were not closed. If the cord be broken, a second shell is formed beneath it, and below this the siphon which traverses the septa.

Neither D'Orbigny nor Oppel have perceived this fact. It is true that it is ascertained with difficulty in small individuals: thus no trace of an aperture is seen in a young *A. pustulatus* from Bellay; whilst an adult shell of the same species, derived from the *Ornater Thon* of Gammelshausen, presents a pyritous crest, which is easily detached, and which proves its analogy with *A. Truellei.* The largest dorsal cavity observed by Quenstedt was presented by a fragment of an Ammonite from the brown upper Jura of Rathshausen, to which he has given, in consequence of this organization, the name of *A. dorsocavatus.* This Ammonite has the same spiral lines and the same high and compressed mouth as the *A. Truellei,* but it has on

its back a denticulated cord of pyrites, surrounded by a proper test, which indicates a dorsal cavity of perfectly unusual dimensions. The traces of the septa and lobes stop towards this cord, which is smooth and without septa. At the penultimate whorl, the canal is even seen empty and surrounded by its test; it may be followed a long way with a hair. Below this canal, the test of the shell, properly so called, is distinctly seen, and still more internally the siphon.

M. Quenstedt thus proves that there is a group of Ammonites in which there is above the back a large open canal without septa, separated from the siphon by a wall, which is the true test of the shell. He calls the Ammonites of this group *Dorsocavati*.

It remains to determine the function of this canal, which only occurs in a small number of types, otherwise very different from each other. It is not to be supposed, in fact, that all the Ammonites which have a dorsal keel are true *A. dorsocavati*; thus the *A. Tessonanus*, D'Orb., presents a perfectly compact fracture. The true Ammonites of this group always present a continuation of the test of the shell at the base of the dorsal canal, so that the keel is detached with facility, and may lead to error.

M. Quenstedt indicates some species which should be placed in the group of the *Dorsocavati*. He has observed the organization above mentioned in *A. radians* from the lias, converted into limestone; and in the species which he calls *Canaliculatus albus*, if it is not detached from the rock, and if in consequence its keel is not fractured. He shows that the *A. canaliculati* of the white Jura are thus distinguished from those which belong to older strata, for they are *dorsocavati*, whilst the latter are not so. In connexion with this he removes some errors of synonymy.—*Leonhard and Bronn, Neues Jahrbuch*, 1857, p. 544; and *Bibl. Univ*. 1858, *Bull. Sci.* p. 287.

Note on the Larvæ of the Spiny Lobster (Palinurus). By M. Coste.

M. Coste has lately communicated to the Academy of Sciences in Paris the interesting statement, that the young larvæ produced from the ova of *Palinurus* are identical in structure with the well-known pelagic genus *Phyllosoma*, of which the species have hitherto been found principally in the Indian Seas. These young Crustacea have a flattened, membranous, diaphanous body, divided into two shields; of these the anterior, which is very large, forms the head; and the second, which is much smaller, bears the foot-jaws and the five pairs of feet, and terminates posteriorly in a short, slender abdomen. The eyes, as in *Phyllosoma*, are borne upon long footstalks; the feet are composed of the same number of joints, terminated by strong claws, and furnished at the second articulation with an appendage composed of three principal pieces, of which the last is furnished with barbs on each side, themselves provided with barbules. In all these points the larvæ agree exactly with *Phyllosoma*, so that there is some reason to suppose that this genus, like *Zoëa*, will have to be erased from the system.—*Comptes Rendus*, March 22, 1858, p. 547.

On the Organization of the Genera Phyllosoma *and* Sapphirina. By Prof. Gegenbaur.

In this memoir M. Gegenbaur publishes a detailed anatomy of *Phyllosoma mediterranea*, a little crustacean which has often been arranged among the Stomapoda, but which appears to be a true Decapod, and of *Sapphirina fulgens*, a little Copepodous crustacean.

In reference to the circulation, the author believes that in the *Phyllosomæ* there exist true orifices which effect a communication either of the arterial capillaries or the large vascular branches with the abdominal cavity. These Crustacea, notwithstanding they are Decapoda, have therefore a lacunar sanguinary system, and are removed, in this point of view, from the common Crab, in which the vascular circulatory system is perfectly closed, as M. Hæckel has lately shown. The liver of *Phyllosoma* is formed of two bundles of blind membranous tubes, which M. Guérin has described as circulatory organs. However, the secreting activity of the liver appears to be very small, and it frequently happens that the food passes from the stomach into the interior of the hepatic tubes.

The *Sapphirinæ* have the property of shining in the light with most brilliant colours, passing alternately from a sapphire blue to a golden green or a splendid purple. This brilliant colouring is seated, according to the author, in the layer of cells which secretes the chitine of the skeleton. Under the microscope, the cells are seen to pass alternately from one colour to the other; and it may be ascertained that the variations of colour of each cell are independent of those of the neighbouring cells. This remarkable property vanishes with life. The *Sapphirinæ* possess two well-developed eyes, each furnished with a cornea and crystalline cone. Between the two eyes is placed a little three-lobed body, which is put in communication with the central nervous system by a small nervous filament. This body contains several refracting corpuscles, and M. Gegenbaur regards it as the remains of the single eye of the larva. It is well known that the single eye of the larva persists in several Crustacea (*Daphnia, Artemia, Branchipus, Argulus*, &c.) in the form of a spot of pigment. The two eyes of *Sapphirina* would not therefore be the morphological analogues of the single eye of other Copepoda (*Cyclopidæ*), but of the more perfect eyes observed in the *Argulina, Daphniadæ, Phyllopoda*, &c., and which are absent in *Cyclopidæ*.—*Müller's Archiv*, 1858, i. p. 43.

On the Metamorphosis of the Pranizæ *into* Ancei. By M. Hesse.

The author states that he has ascertained by continued experiments that the *Pranizæ* are the larvæ of *Anceus*.—*Comptes Rendus*, March 22, 1858, p. 568.

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END OF THE FIRST VOLUME.

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